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SHELBURNE FALLS POWER PLANTS*

No. 3 Plant, No. 2 Plant, Transmission Lines and Switching System

FOLLOWING DOWN THE RIVER, we find it flowing southbound, between the slopes of Prospect and Bald Mountains, past the final rest of the pioneers who first came to conquer these hills, and on to the town which the power of its falls has built. Here, since 1837, the Lamson & Goodnow Co., and the H. H. Mayhew Mfg. Co., have had developed rights which have been acquired by the New England Co., and the dam rebuilt on nearly the same location. The general layout of the new development is seen in Fig. 12, and a view in Fig. 13, the plant in that figure being at the left, the headworks directly behind it, the fore bay extending up-stream and the dam at the right up-stream from the chimney of the Lamson & Goodnow Works. From the pond above the dam head gates admit water into a covered concrete conduit 17 ft. wide by 12 ft. 6 in. high which extends through the grounds of the Lamson & Goodnow plant, 600 ft. to the forebay.

*Continued from page 1136, December 1 issue.

The old dam was of timber crib construction, while the new one is of concrete with a spillway 456 ft. long by 15 ft. high standing on a rock ledge and inclined across the river, as shown, to follow the crest of the rock. On top of the spillway 5 to 6 ft. of flash boards will be used and at the right hand end of the dam, near the headworks, submerged and surface sluices are built. At the inlet to the conduit is a converging intake divided into 2 bays by a concrete pier and having 2 timber head gates with steel stems in each bay. Each gate is operated by an Exeter Machine Works, 50,000-lb. hoist. One of the gates has a 24 by 24-in. filler gate.

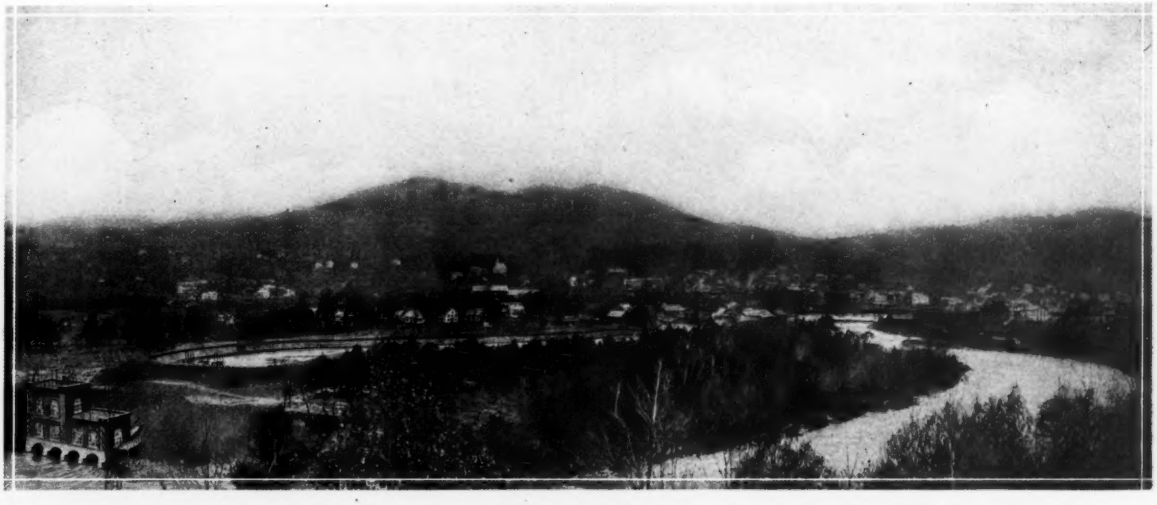


FIG. 13. SHELBURNE FALLS PLANT NO. 3, SHOWING POWER HOUSE, HEADWORKS, FOREBAY AND DAM

Special attention has been given in the design of this inlet to prevent taking in surface ice or anchor ice. Above the screens and headgates the breast wall projects about 6 ft. with a flat concrete roof placed so that it will always be under water, as shown in Fig. 12A. Above this roof an opening closed by stop logs pierces the dam abutment and a movable

timber crest at the front edge of the roof provides a surface skimming effect so that water may drain over this crest into the ice sluice and thus carry the surface ice out through the hole in the dam abutment. Partly as a spillway from the conduit and partly to care for the slush and anchor ice, a sluice is provided with outlet discharging below the dam and located just

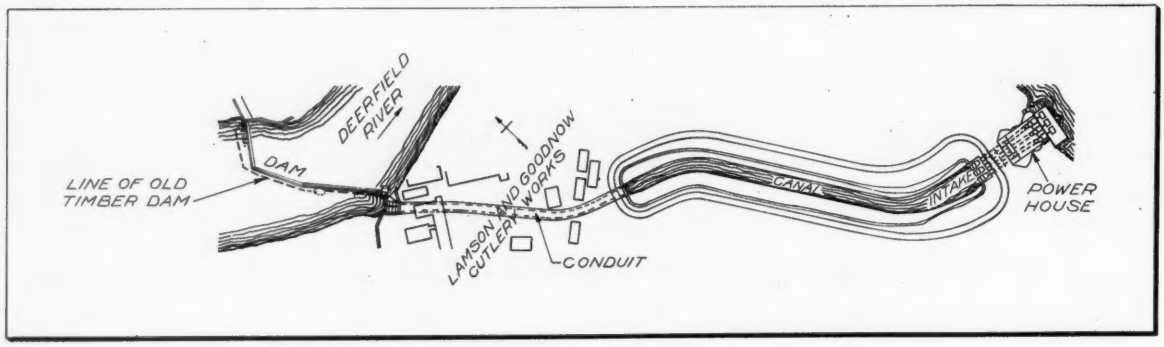


FIG. 12. PLAN OF DAM AND INTAKE OF NO. 3 PLANT AT SHELBURNE FALLS

behind the gates. This opening has a roof on which the gate hoists are mounted. After passing through a submerged and restricted opening, anchor ice tends to boil to the surface and will therefore rise into this sluice or chamber, from which it may be spilled over stop logs.

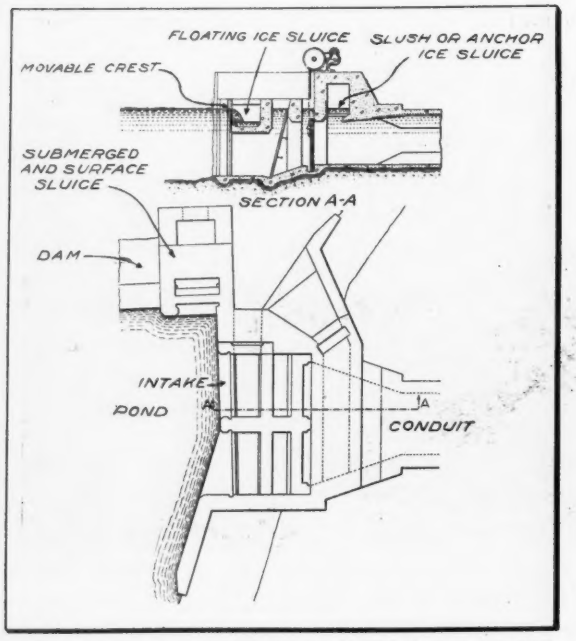


FIG. 12A. SECTION OF INTAKE, SHOWING ICE AND SLUSH SLUICES

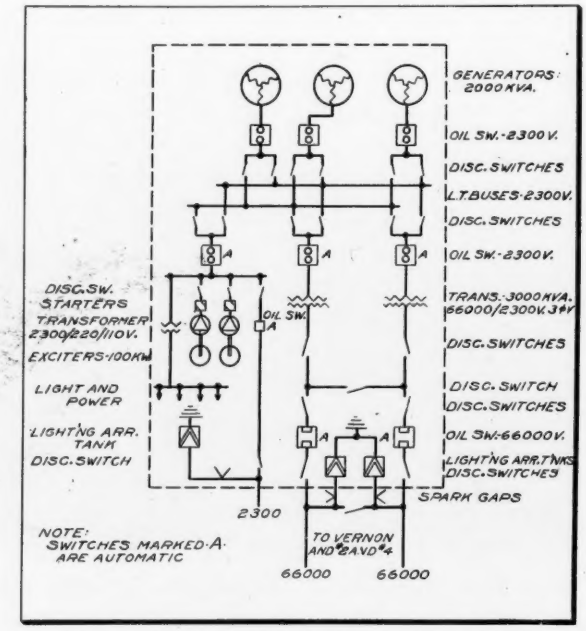


FIG 15. GENERAL CONNECTIONS OF NO. 3 PLANT

At its lower end the conduit discharges into a long forebay or canal which is partly excavated and partly banked in, 36 ft. wide at the bottom and 23 ft. deep. Water faces are rip rapped with embankment slopes 2 to 1. This canal is 920 ft. long with the lower end widened to accommodate the headworks for the penstocks. Head gates, penstocks and waterwheel construction are exact duplicates of those at the No. 4 plant; also the electrical equipment is the same, except that only one set of switching apparatus is needed as the No. 3 station connects to the main transmission line by a branch line. The station is of brick and steel construction with concrete foundation and carrying the river side of the building on arches. The control switchboard is on the operating floor, opposite the generators, with all cables for connecting to the generators and the buses carried in floor conduits. A gallery between the first and second floors carries the storage battery for operating the remote control switches and an oil storage tank for lubrication and for filling the transformer cases. Motor generator sets, which are located on the operating floor, are in duplicate, 100 kw. capacity, running at 125 volts and driven by 2300-volt induction motors at 900 r.p.m. From the switchboard of No. 3 station a 2300-volt power line is carried out to furnish power to the plants and buildings in Shelburne Falls. In other respects the plan of connection is the same as for No. 4 station, except that as no lines pass through the station transfer switches are unnecessary.

As shown in the plan of station No. 4, the generators are symmetrically spaced, 22-ft. centers, and are designed to furnish 503 amperes per terminal with maximum temperature rise of 72 deg. F. at full load for 24 hr., with 80 per cent power factor; and 100 deg. F. rise with 25 per cent overload for 2 hr. The high-tension switches have a capacity of 150 amperes at 70,000 volts and are connected by leads to transformers overhead and operated by solenoids. For inside wiring of the high-tension system copper tubing is used in order to give greater stiffness. In each station 2 transformers are installed, the 3 phases being handled in a single transformer and each transformer having a capacity of 3000 kva. They are connected in star on the secondary, are oil filled and water cooled, and are mounted on rails which lead to a center opening over I beams which can be removed and the transformer lowered to the operating room by means of a Northern hoist of 50,000 lb. capacity. For handling the parts of generators and other material in the operating room a 15-ton hand-operated crane made by the Northern Machine Works is provided. Water for cooling the transformers and the front waterwheel bearings is furnished by gravity from the wheel casings, a Lawrence 1½-in. centrifugal pump driven by a 1½-hp. 110-volt induction motor running at 800 r.p.m. handles transformer oil.

Water is piped to the bearings and to the transformer piping in the second story and discharges through the tail race. That for the transformer coils is passed through a strainer before being sent to the cooling pipes. Each transformer is placed in a brick and concrete well with one wall removable so that it can be taken out in case of emergency. This well catches oil from any leakage and in case of emergency the oil from the well and the transformer can be dumped into the river through a quick opening valve and a 3-in. outlet pipe.

The operating board is 16 ft. 4 in. long, containing 10 panels, and is placed 70 in. from the wall, with a row of auxiliary panels 33 in. from the wall. Rheostats for the fields of exciters and generators are mounted on the frame above. The alternating-current instruments are all of transformer type with no voltage over 250 entering the cases, and include the usual equipment of recording and indicating voltmeters, ammeters, synchroscope, power factor indicator, wattmeters, frequency indicator testing jacks and a Tirrell regulator. The station is connected in delta on the low-tension side and star on the high-tension, with neutrals grounded. On the front of the board is a diagram in copper of dummy buses, showing by a bull's-eye the conditions of each oil switch and disconnecting switch

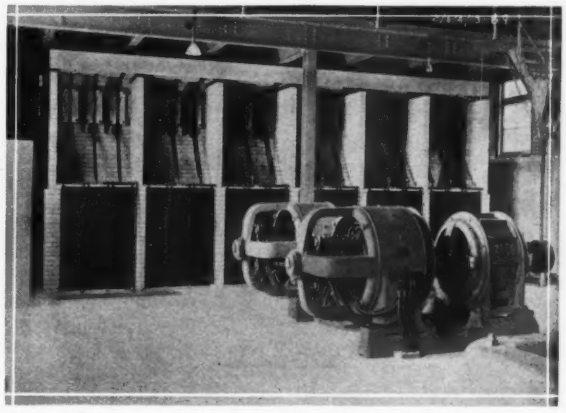


FIG. 16. EXCITER UNITS AND OIL SWITCH COMPARTMENTS FOR 2300-VOLT CIRCUITS WITH DISCONNECTING SWITCHES ABOVE

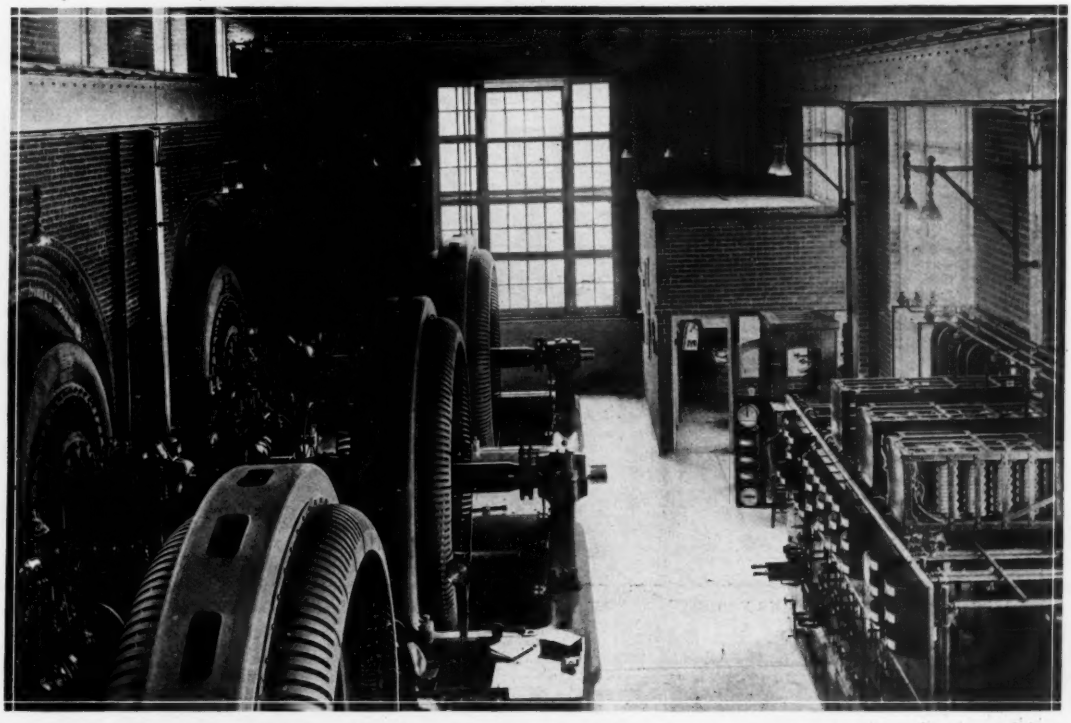


FIG. 14. GENERATORS, GOVERNORS, SWITCHBOARD, TELEPHONE BOOTH AND CHIEF OPERATOR'S OFFICE IN SHELBURNE FALLS PLANT

and just how the station is operating. In the No. 3 station, 2 exciter panels are provided, 3 generator panels, 2 transformer panels, one main line panel and a local feeder panel for the Shelburne Falls power line.

Untreated oil is stored in tanks on the first floor and used for lubricating purposes. On the gallery is located an oil filter press and pump which draws the untreated oil and passes it into the dry oil tank, from which the supply is drawn to fill the transformer cases. This oil enters the top of the cases and is drawn off either to the untreated tanks for purification or in emergency into the tail race. The water is piped from the wheel casings and forced through the bearings and transformer piping continuously.

No. 2 Plant

FOLLOWING on down stream from plant No. 3, we pass the development of the Greenfield Electric Light & Power Co., at Gardner Falls, where a head of 39 ft. is utilized to develop 800 kw. at 10,000 volts, the backwater of this plant reaching practically up to the tail race of the No. 3 plant of the New England Power Co. Below this Gardner Falls plant is located the No. 2 plant of the New England Power Co., at a point about 3 miles from the No. 3 plant. Here a dam 90 ft. high, in maximum section, by 450 ft. long consists of an ogee spillway 276 ft. long, a 30-ft. sluice section and 76 ft. of headworks joined to a 62-ft. shore abutment. Provision is made for carrying 7 or 8 ft. of flash boards. The power house is located just below the penstock headworks, which have their crest 16 ft. above the top of the spillway. Directly below the surface sluices are 2 submerged Venturi type sluices, each protected by stop log grooves and round bar screens and provided with a 48-in. Chapman gate valve with rising stem. The openings to the surface sluices have stop log grooves and timber gates which may be operated so as to permit the waste water to flow either over or under them. The total capacity of the sluices is about 4000 cu. ft. a second, which will prevent the rise of many smaller floods above the top of the flash boards. At the power house just below the dam the normal head will be 58 ft., the short pen stocks and draft tubes being practically all in concrete, as shown on the cross section. The headgate equipment is similar to that at the other 2 plants, also the water wheels, generators, transformers and switching equipment. The main line passes through the station, and the connections, therefore, are the same as for plant No. 4.

Transmission Lines

THREE types of pole construction are used on the system, the wood pole with cross arms of straight or wishbone type, and pin type insulators for 20,000 volts or under; the A frame steel tower with pin type insulators for 66,000 volts and the square steel tower with suspension insulators for 110,000 volts. At the present time 66,000 volts is the highest carried, but later it is intended to carry 110,000 volts on the trunk line, which will run from upper Deerfield plants along the Deerfield River to Hoosac, Shelburne Falls, and then across country to Ware and Millbury, and by a future loop to Providence, a distance of 125 miles. This line loops, as shown on the transmission map, with a line from Vernon through Fitchburg, Clin-

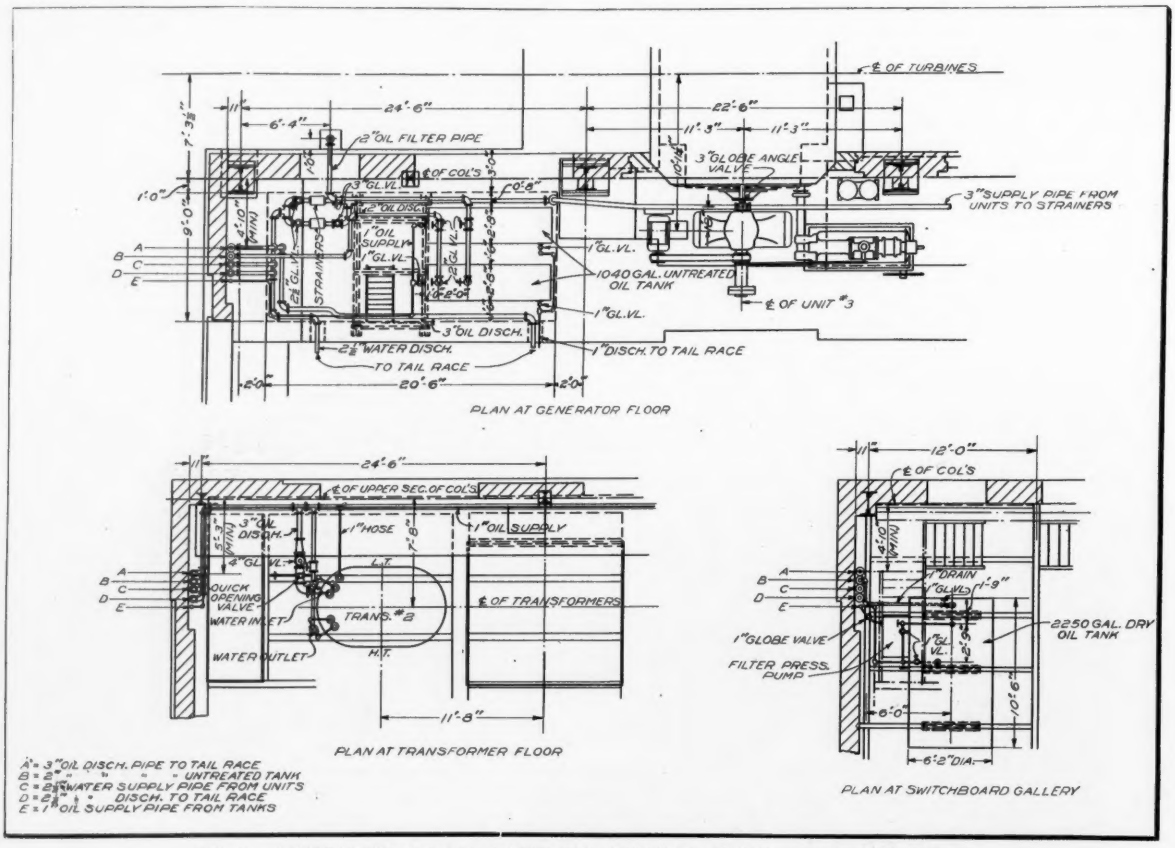


FIG. 18. SYSTEMS FOR OIL AND WATER FOR COOLING BEARINGS AND TRANSFORMERS

ton and Worcester to Millbury, where a large substation is established to tie the 2 lines together.

A feature of the system is the fact that by reciprocal agreement with some of the light and power companies to whom the Connecticut River Transmission Co., sells large blocks of power, their steam generating plants supply current to the system at any time when it may be needed to supplement the company's own auxiliary steam plants. In the present development, the first line to be built was that from Vernon to Shelburne Falls with A frame towers, as shown in Fig. 23. Power was used from this line in drilling the tunnel at the No. 4 plant and in other construction work. The

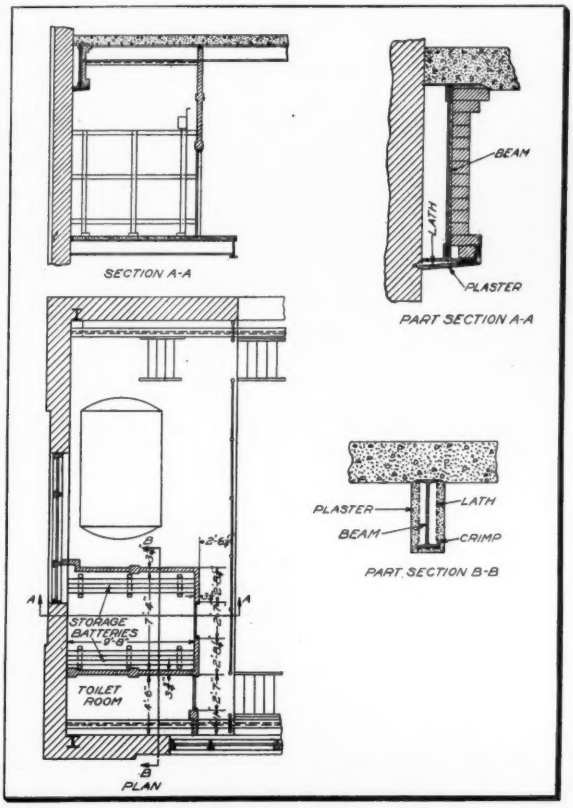


FIG. 17. DETAILS OF STORAGE BATTERY, OIL TANK AND TOILET ARRANGEMENT

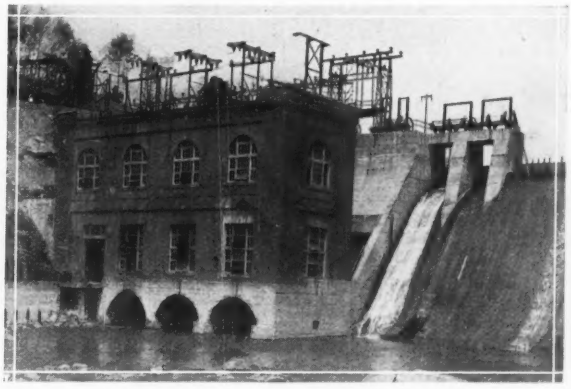


FIG. 21. NO. 2 PLANT FROM DOWNSTREAM, SHOWING SUBMERGED AND SURFACE SLUICES AND FLASH BOARDS

wire used on this system is No. 1, medium hard, 7-strand copper conductor on the electric circuits, and ½-in. copper-clad stranded for the ground line. A telephone line of No. 5 copper-clad wire is also installed. This line is 20 miles long, has 13 towers to the mile, and each mile there is one tower made of 2 A frames tied together into a square tower, also the square towers are used at angles, and where, from the contour of the country, long spans are necessary. Two heights of towers are used, according to the ground surface, 35 and 41 ft. to the bottom cross arms. The power wires are transposed once in the length of the line, and the telephone wires every other pole.

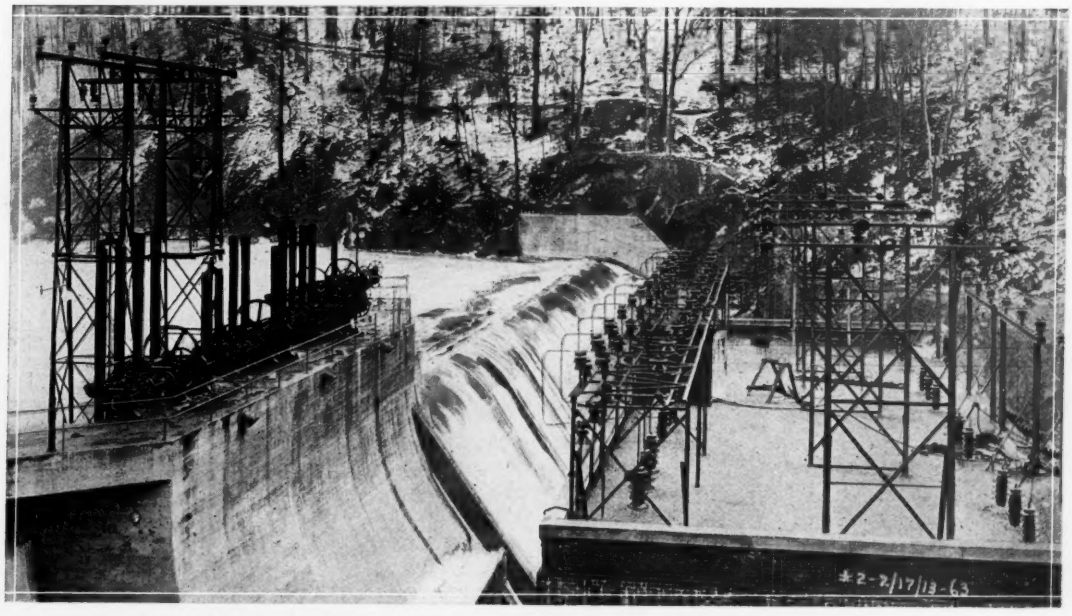


FIG. 19. DAM, HEADWORKS AND LINE CONSTRUCTION AT PLANT NO. 2, UPPER BARDWELLS

Arrangement of the line wires, where they come into a station, is shown in the section of plant No. 2, Fig. 20. The line wires are dead ended by suspension insulators which are fastened to the station wall. From these line wires, taps are carried to insulators on a steel framework on the roof, as shown in the sectional view and in the photographs of the stations. These taps lead to horn gaps of the ground wires and from them leads are taken through roof insulators to the disconnecting switches in the station below. The

Leads from the taps to the station are spaced 5 ft. centers and carried through 5-part Thomas Roof Bushings, shown in Fig. 22. The selector switches are all mounted on the roof,, outside the station, as indicated in the connection diagram of No. 4 plant. Brilliant illumination of the roof by means of 16 cp. incandescent lamps in waterproof sockets is provided, so that necessary switching operations may be carried on there at night.

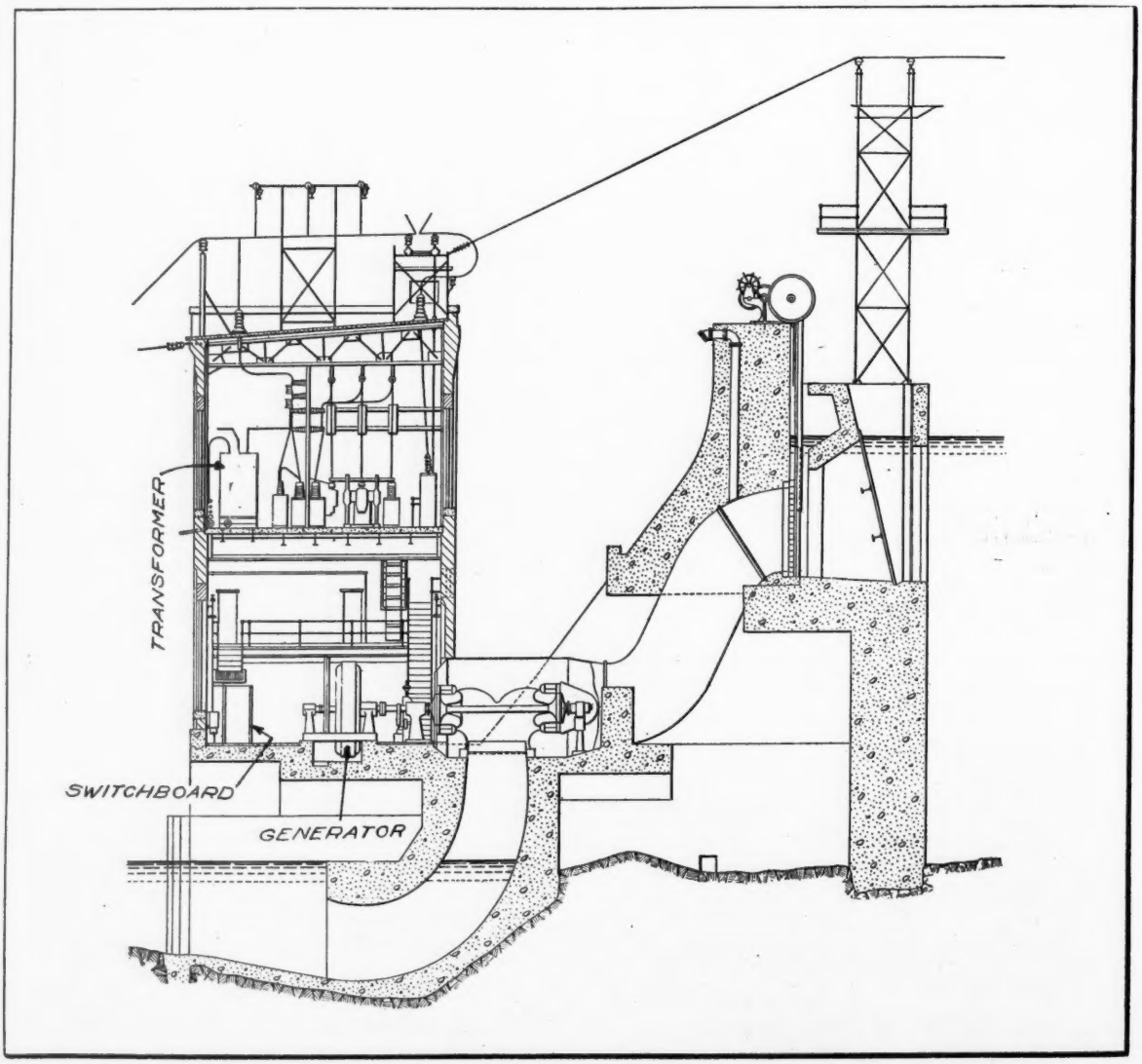


FIG. 20. SECTION OF NO. 2 PLANT AND HEADWORKS, SHOWING PENSTOCKS AND ARRANGEMENT OF MACHINERY

insulators for supporting the wires on the roof are built with 4 petticoats and mounted on horizontal framing made of steel I beams joined in latticed construction and with diagonal bracing top and bottom. The lines are spaced 8 ft. apart horizontally and are carried 10 ft. above the roof. The steel framing is supported by uprights with their feet in the concrete of the roof and with copper flashing and asphaltum seal.

From station No. 4 to the Hoosac Tunnel plant square towers are used, 10 to the mile, and 50 ft. high to the cross arms, 75 ft. to the tip. The wires are strung on suspension insulators of the Locke type, the power wires being of No. 1 hard drawn copper, 3 strands, and the ground wire of 5/16-in. copper clad. The telephone wire is run on a separate wood pole line with 25-ft. poles, 30 to the mile, and consists of No. 10 copper clad wire transposed every fifth

pole. The line from Providence to Shelburne Falls is of the same type towers, but has heavier conductors, these being No. 00, 7-strand, and a ground wire

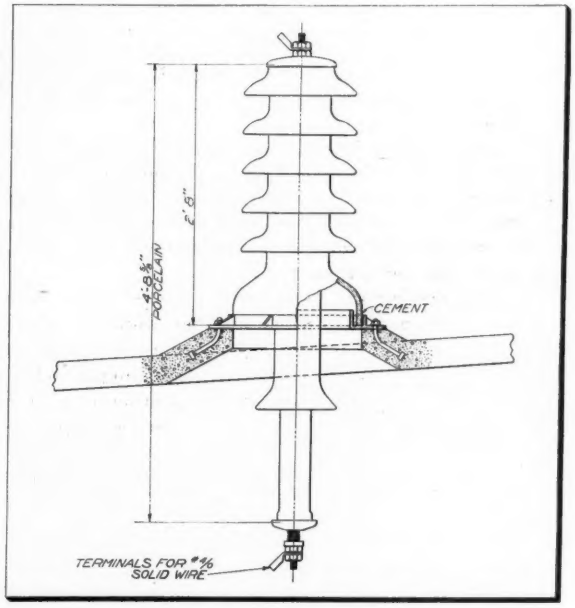


FIG. 22. DETAIL OF ROOF INSULATOR FOR HIGH TENSION WIRING

⅜-in. galvanized steel stranded, the telephone line being of No. 6 copper clad on separate poles. For the suspension insulators on the 110,000-volt line, 6 disks are used for the suspension and 7 for the strain. The

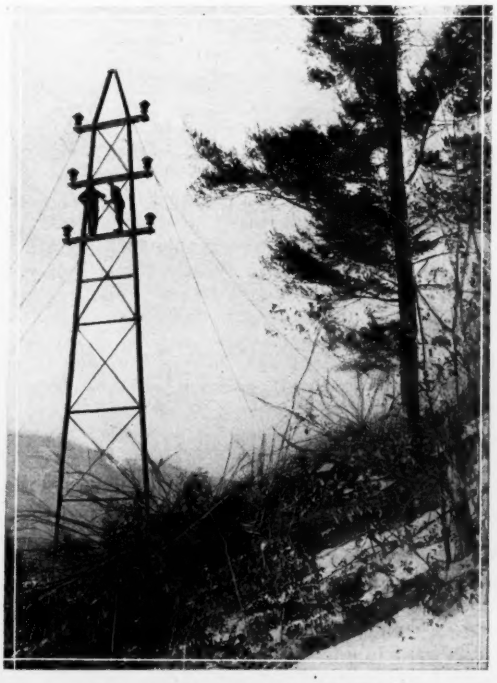


FIG. 23. A FRAME TOWER FOR 66,000-VOLT LINES WITH PIN INSULATORS

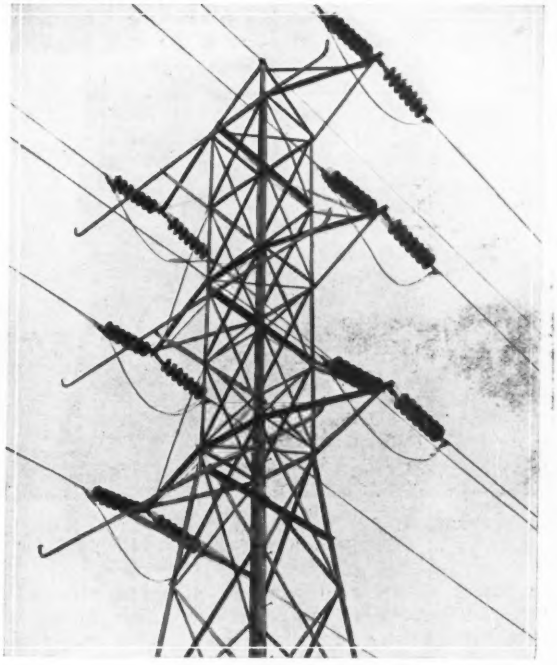


FIG. 24. SQUARE TOWER WITH SUSPENSION INSULATORS FOR 110,000-VOLT CIRCUITS

power wires are transposed every 20 miles. The loop wire from Millbury to Worcester, Fitchburg and Vernon is carried on square galvanized steel towers with pin type insulators. Leading from this loop are

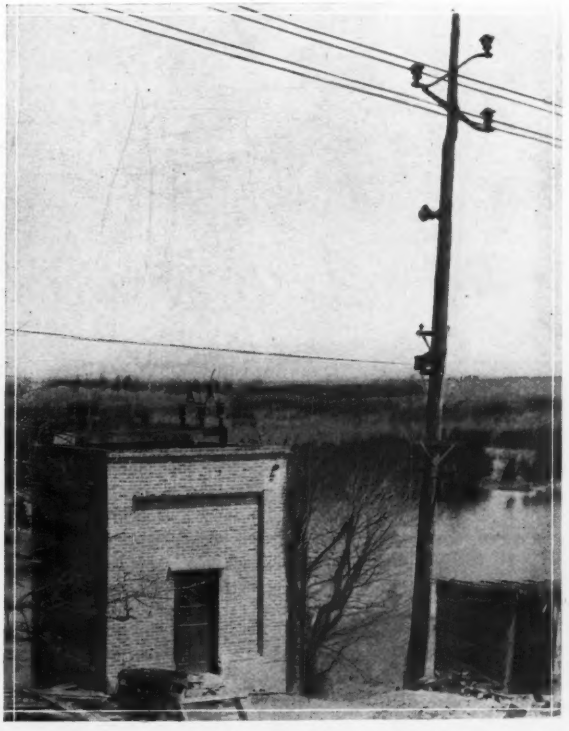


FIG. 25. WISHBONE TYPE INSULATOR AND WOOD POLE LINE AS USED ON GARDNER-BARRE LINE

local lines from Gardner to Barre, and to Troy and Jeffrey, N. H., these being of wood pole construction 40 ft. to the cross arm, 35 poles to the mile and carrying No. 6 copper clad wire on wishbone cross arms with 66,000-volt pin type insulators. The ground wire is the same as the power wire and the telephone wire, which is carried on the same poles, is No. 10 copper clad. In all cases of pole lines a 60-ft. right of way has been cleared and for the tower lines a 100-ft. space.

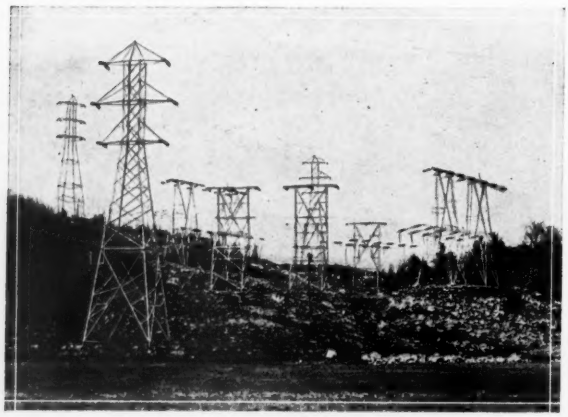


FIG. 26. SWITCHING STATION AND CROSSOVER AT AMHERST WITH TURNER'S FALLS SYSTEM

Another peculiar feature in the transmission system is the establishment at Leverett, Mass., of a switching station to connect the transmission line from Shelburne Falls to Millbury with the system of the Amherst Power Co., having a hydraulic development at Turner's Falls. Fig. 26 gives a view of this switching station and Fig. 27 shows the details of the arrangement. From the diagram of connections it is clear that either circuit of either system may be switched on to the corresponding circuit of the other system, feeding current in or taking current out, as may be necessary, through the transformers, the oil switches and the meters.

In conclusion, our acknowledgment is due to the officials of the power construction company, and to its engineering staff for courtesies in furnishing data in regard to the article, for hospitality on our visits to the various plants and for blueprints and photographs of the installations.

All engineering and construction work on the Deerfield development has been carried out under the direction of the Power Construction Company of Shelburne Falls, Mass. In addition to the staff mentioned on page 1127, Frederick P. Stearns has also acted as consulting engineer on the Somerset Dam in particular. The Somerset Dam, the principal transmission lines and much of the work at the various plants has been carried out directly by the Construction Company, while the remaining work has been subcontracted.

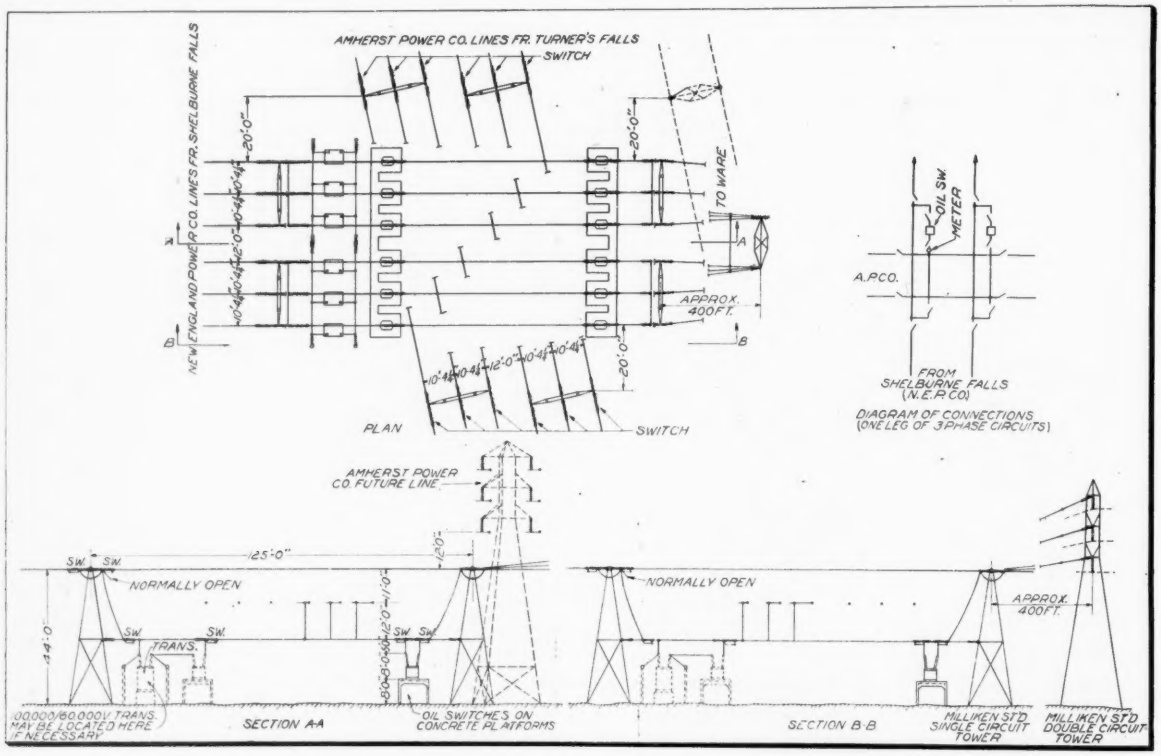


FIG. 27. DETAILS OF AMHERST CROSSOVER AND SWITCHING STATION

Baker, Ayling & Co. of Boston have acted as bankers and fiscal agents for the allied Connecticut River Power Co. and New England Power Co. interests. Chace & Harriman, Inc., also of Boston, have largely conceived and worked out the propositions and are in intimate touch with their management.

LITTLE ICE PLANTS IN GERMANY

High Economy Reached By Employment of Labor Saving Devices and the Locomobile

By Sterling H. Bunnell

WE are familiar with the cry that the small business has no chance for success in these days; however, great size does not always bring success, nor need small size insure failure. It is when the small concern becomes large without changing its methods from those proper only for a small business, or when it is organized with all the complications proper for a great corporation, that failure is invited from the first. Ice manufacturing plants in America are often of great size. They produce clear ice in large blocks, from condensed exhaust steam, at a cost which allows them a good profit. Small plants, however, are generally designed on lines so nearly identical with the large plants, that the interest, upkeep, power and labor charges are nearly as great in small as in large plants. The cost per pound of ice produced becomes so high accordingly that nothing but high selling prices and absence of competition can save the small plant from being swamped by its operating costs.

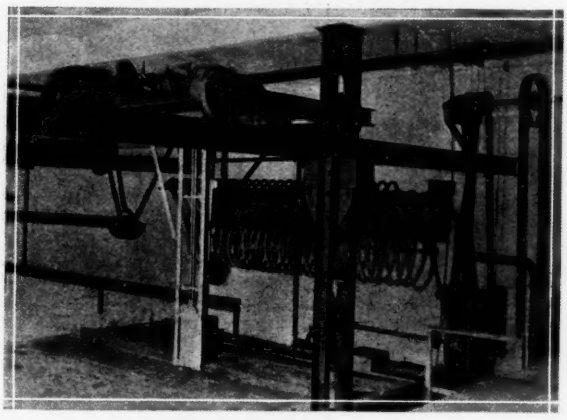


FIG. 1. ELECTRIC CAN-LIFTING CRANE AND MULTIPLE CAN FILLER

It is interesting to observe the features of some small ice plants which meet successfully conditions even more difficult than generally exist in this country. In German cities, ice is frequently furnished by the large breweries without charge to households purchasing beer for home consumption. In consequence, the market for ice, and the price as well, are limited. Manufactured ice for sale to the consumers not supplied by the breweries, must be made in small plants, and by the most economical methods. In Munich is a plant operated by a water wheel of the breast type, under a very low head. The compressor is rope driven from a jackshaft, and the refrigerant is carbon dioxide. The expansion coils are placed in a brine cooling tank, from which brine is circulated through the ice making tank by a pump. As the water supply of Munich is exceptionally clear and healthful, though hard, no expense is incurred for distilling the water, or for removing the dissolved air by heating and boiling away part of the water and then cooling it again ready for filling the ice cans.

The usual American practice is to provide an extremely light crane and to pull 1 or at most 2 cans every 5 min., then empty and refill them with water. This requires the constant labor of 1 or 2 men. In the small German plant, all the cans in a full row across the tank are secured in a frame, so that they can be lifted, transported, thawed and handled together. The row of cans is usually refilled from a corresponding row of nozzles controlled by a single valve. After refilling with water, the frame with its cans is carried over the tank by the crane and lowered into the space at the end farther from the thawing tank. To fill the gap left by the previous removal of the row of cans, all the can frames are pushed forward by the operation of pushers, driven by pinions and racks. The pushers, by moving slowly forward, shove all the can frames forward toward the opposite end of the tank. In this way it is made possible to insert the cans of water to be frozen, always at the end of the tank nearest the brine outlet, and to pull the finished ice from the opposite or colder end.

The ice is made reasonably clear during the process of freezing by a stirring rod in each can. The rods are connected to wooden staves long enough to reach entirely across the tank. After lowering the row of cans, a staff of rods is placed in position, a rod projecting down to the bottom of each can, the ends of the staff resting on reciprocating bars at each side of the tank. The bars are moved continuously by gearing and carry the cross-staves resting on them, with the attached rods, back and forth, thus stirring the water during the process of freezing and dislodging the air. As the cans are moved forward after each completed row is pulled, the rods attached to the staves move forward with the cans. As each row of cans reaches a position distant 3 or 4 rows from the pulling position, its rods are removed to permit the ice to close solid.

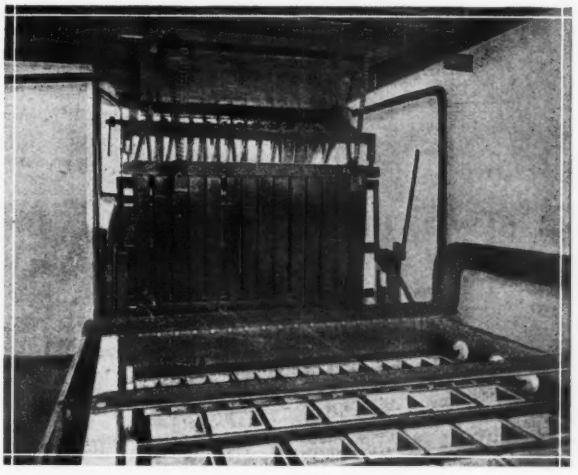


FIG. 2. LIFTING ENTIRE ROW OF CANS TOGETHER

With this system of handling the cans together instead of singly, it requires but a few minutes labor

of one man at intervals to do all the work in connection with the ice tank, and the rest of the workman's time is available for weighing ice, loading wagons, and all the incidental work of the plant. In the Munich plant described, there was but one man employed for all the work of the plant, and his time was not fully occupied.

Another interesting small plant is located at Ludwigshafen. Electric power is supplied to small and large users here as elsewhere throughout Germany, from large central stations, by lines reaching practically every point in city and country, and the rate is only 1¼ cents per kilowatt-hour. The refrigerant used in this plant is sulphur dioxide. The water supply for condensing and ice making is pumped from a well on the premises, and is quite cold. The water for ice making is filtered, but not boiled or deaerated. The same features of handling the cans a row at a time, and of agitating the water during freezing by rods, are found here also. The labor cost of this plant is accordingly extremely low.

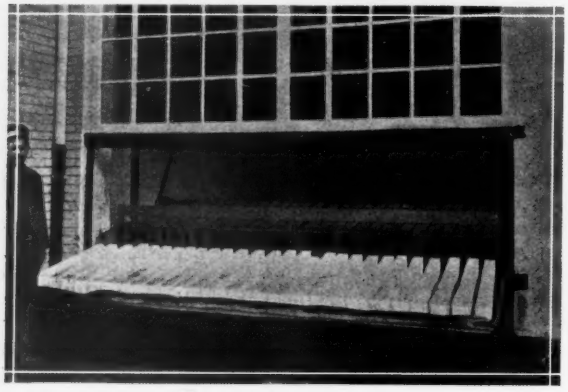


FIG. 3. DUMPING ENTIRE ROW OF CANS

Remarkable economy is obtained in a small steam driven ice making plant at Mannheim. The fuel used here is wood sawdust, and the steam power plant is a Lanz "locomobile" or complete portable unit consisting of an internally-fired horizontal high-pressure boiler, a compound engine mounted on it, superheater, reheater, and condenser, and air and feed pumps direct connected to the engine shaft. The locomobile could produce a horsepower on 1¼ lb. of good coal and does produce a horsepower on about 3½ lb. of sawdust. The ice making apparatus consists of an ammonia compressor, belt driven by the locomobile, an atmospheric condenser of usual form located on the roof, a can ice making outfit, with stirring rods, and a crane and hoist for pulling complete rows of cans in the same manner as in the other plants described above. The labor employed comprises fireman, engineer and one man to pull and refill cans, lower ice to storage by an elevator provided, and load and check off ice as delivered to wagons for sale.

The owner and engineer of this plant stated that the daily output was 67,500 kg. of ice per day, and the fuel consumption was 9000 kg. of sawdust per day, showing a production of 7½ lb. of ice per pound of sawdust. This figure looks impossible, for it would mean at least 18 lb. of ice per pound of coal, yet calculation shows that it is within easy reach. Starting with water at about 70 deg., a ton can be frozen with not over 1.4 tons of refrigerating capacity, requiring little more than 2 hp. for 24 hr. obtainable from about 2½ lb. of coal per hour burned in the locomobile. The amount of sawdust claimed to be burned is 11 lb. per hour per ton of ice made, which would allow over 4¼ lb. of sawdust as equivalent to a pound of coal, which is liberal.

While this remarkable economy is obtained in a plant operating without the extra expense of producing transparent ice from warm distilled water, it is easy to show that the usual results produced in making the best ice are far below easy possibilities. By the use of multiple effect evaporators with a duty of only 40 lb. of water produced per pound of coal, or 50 lb. of coal per ton of water, the extra coal consumption required for making pure, transparent ice would be only 2.1 lb. per hour per ton of ice produced per day. Adding this to the amount required for power in the economical locomobile, or 2½ lb., the total, 4.6 lb., is at the rate of one pound of coal to 18 lb. of ice. The average American ice plant requires 5 lb. of coal per hour per engine horsepower, and 2½ hp. per ton of ice, making 12½ lb. of coal per hour per ton of ice, to be compared with 4.6 lb. above; or 6½ lb. of ice per pound of coal, to be compared with 18 lb., obtainable by using really economical methods.

MIXED-PRESSURE STEAM TURBINE*

A Mixed-Pressure Turbine Installation

By E. D. Dickinson

A DESCRIPTION of a specific installation may be of interest in showing under what severe conditions a mixed-pressure turbine will operate successfully. Figures 8 and 9 show charts of the low-pressure steam supply. From Fig. 8 it will be seen that the supply was interrupted at the rate of 24 times an hour, and during this time the machine would automatically change over and carry the same load on high-pressure steam. Figure 9 shows how the regenerator would carry the load for several minutes after it had been in operation a sufficient time for the water to become thoroughly heated. According to the chart, the turbine carried its load approximately 1500 kw., for about 1.8 min. on low-pressure steam furnished by the regenerator. From the chart, the pressure drop on the regenerator was 2 lb. The regenerator in this installation holds 240,000 lb. of water. From the curve of Fig. 6, for a range of pressure between 17 and 15 lb. absolute, 152 lb. of water will generate 1 lb. of steam; therefore $\frac{240{,}000}{152} = 1580$ lb. of steam regenerated. Under operating vacuum conditions, the turbine would take approximately 36 lb. per kilowatt-hour = 0.6 per kilowatt-minute; 0.6×1500 kw. = 900 lb. per min. $\frac{1580}{900} = 1.75$ min. out of the 15 min. or 11.6 per cent of the time of low-pressure operation.

Records for one month showed that the regenerator carried the turbine for 11.5 per cent of the time of low-pressure operation; also, that the turbine operated 39 per cent of the time high pressure and 61 per cent of the time low pressure. Therefore the regenerator carried the load for 7 per cent of the time of operation. After making allowances for power used by auxiliaries, etc., there was a net output for the month, generated

*Continued from page 1130, December 1 issue.

by low-pressure steam, of 298,500 kw.-hr. 298,500 × 0.3 cents per kw.-hr. = $895.50 per month. Allowing for labor and supplies, a profit of approximately $758.00, or $9096 per year should be credited to the investment.

In estimating the cost of a low-pressure turbine installation, due allowance must be made for the cost of necessary boilers, turbine, condensers, etc., to generate the same power on high-pressure steam. That is, the net value of power generated on low-pressure steam is the interest on the difference between the cost of a low and a complete high-pressure installation.

During a considerable portion of the periods of low-pressure operation there was an excess of low-pressure steam, and therefore an increase in the regenerator capacity would have increased the total power generated by low-pressure steam. The least expensive method of securing the extra capacity is to arrange the regenerators so that they will continue to give off steam at pressures below atmosphere. The following calculations will show approximately the extra power that should be regenerated with the arrangement shown in Fig. 7.

Between 15 and 13 lb. average load, 1500 kw. at 40 lb. per kw.-hr.

Between 13 and 10 lb. average load, 1200 kw. at 42 lb. per kw.-hr.

Between 10 and 8 lb. average load, 830 kw. at 48 lb. per kw.-hr.

Regenerators contain 240,000 lb. water.

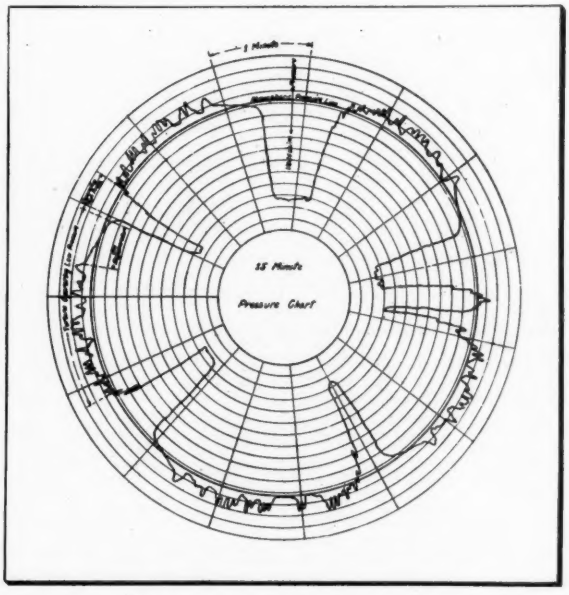


FIG. 8. CHART SHOWING LOW-PRESSURE STEAM SUPPLY

For a pressure range of 15 to 13 lb. abs., 135 lb. water will regenerate 1 lb. of steam.

$$\frac{240{,}000}{135} = 1777 \text{ lb. steam regenerated.}$$

40 lb. per kw.-hr. = 0.66 lb. per kw.-min.

0.66 × 1500 kw. = 1000 lb. per min.

$$\frac{1777}{1000} = 1.77 \text{ min.}$$

1.77 × 1500 = 2655 kw.-min.

Similarly, between 13 and 10 lb. absolute, there would be regenerated 4400 kw.-min.; and between 10 and 8 lb. absolute, there would be regenerated 3090 kw.-min.

Total power regenerated at one time = 10,070 kw.-min.

Time required for pressure to drop = 3 + minutes.

Assume that twice per hour the engine is down for over 3 min., after the pressure in the regenerators has dropped to atmosphere and after the engine has

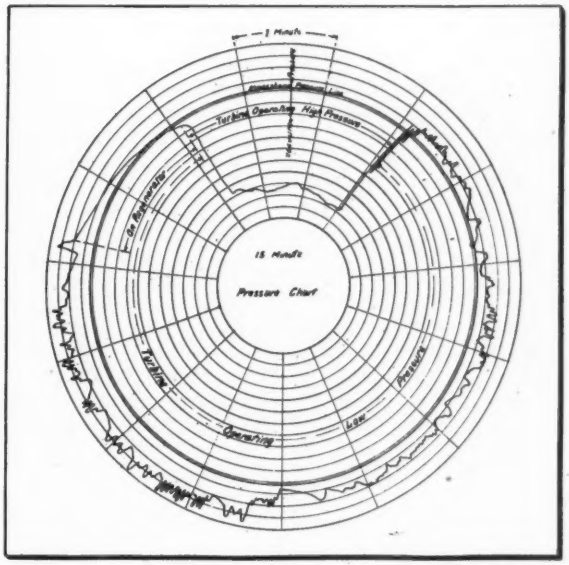


FIG. 9. CHART SHOWING PERFORMANCE OF REGENERATOR

been running for a sufficient length of time to heat the water to 213 deg. F. Then there will be developed from steam below atmospheric pressure 2 × 10,070 = 20,140 kw.-min. per hour, or 336 kw.-hr. per hour.

In one month of 550 hr. operation, there would be developed 185,000 kw.-hr. per month. Making allowance for power used for auxiliaries, etc. (approximately 25 per cent), there remains 138,500 kw.-hr. net per month. Allowing 0.3 cents per kw.-hr. for the power less 0.058 cents per kw.-hr. for cost of labor, there remains 0.242 cents per kw.-hr. net, 138,500 × 0.242 = $335.00 per month, or $4000 per year additional, which might be credited to the installation.

These figures, of course, are approximate, and would vary with the character of the operation. It is readily conceivable, however, that, under certain conditions of operation, even greater credit would have to be given the turbine and regenerator and that only at infrequent intervals would the turbine carry full load on high-pressure steam.

Local conditions must all be carefully investigated and thoroughly understood, before recommendations can be made as to the type of machine best suited for any particular case. There are undoubtedly many places where the installation of a mixed pressure turbine would give the best returns on the money invested for increased generating capacity, whether this be considered on the basis of a lower cost per kilowatt-hour generated, or the increased output as interest on the money invested.—General Electric Review.

HEATING AND VENTILATING LARGE BUILDINGS

Air Filters and Washers

By Chas. L. Hubbard

THE fact that 1 cu. in. of city air is estimated to contain an average of 3,000,000, or more, dust particles, shows the importance of providing some method of filtering or purifying it before it is distributed for use in a building. The dust of cities is made up largely of sand, ashes, soot, pulverized excreta of animals, lime, brick dust, and steel abrasions from elevated and street car rails. In addition to these, there are masses and clusters of many kinds of micro-organisms. Although dust may be annoying, it is not dangerous, unless it contains the living germs of various diseases. This may occur, however, in large cities where dust is allowed to accumulate and where the street-cleaning service is limited or not properly carried out. While the removal of dust from the air employed for ventilating purposes is chiefly to prevent it from soiling the building and its contents, still dust containing disease germs may also be removed, thus rendering the air more healthful for breathing.

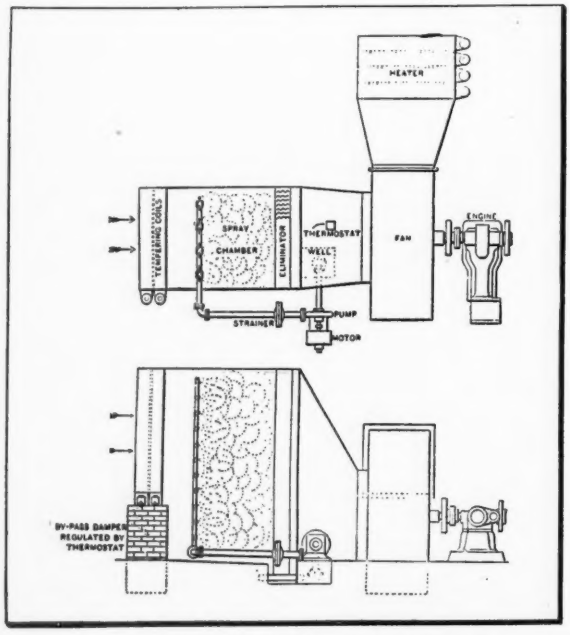


FIG. 1. TYPICAL AIR WASHER AND PURIFIER

Air washing or purifying is wholly a mechanical process, and the germs are simply washed out with the dust which contains them, and not killed. In addition to the above, washing the air gives it a freshness and renders it less irritating to the air passages of the throat and nose.

The older method of filtering the air supply was by means of cheese cloth or other open material. While this material will remove the coarser particles of dust, it requires a large filtering surface, else it will materially cut down the air supply. Furthermore, cloth filters must be frequently cleaned, because the accumulation of dust clogs the openings, thus preventing the free passage of air through them. In order to be of any practical value, such a large area is required as to prohibit its use in city buildings; furthermore, the work of cleaning is an important matter to be considered, as in many cases this must be done once in 24 hr. to prove effective.

The obstacles in the way of dry filters have led to the development of the air washer, of which there are many different designs in satisfactory use at the present time.

A typical washer or purifier is shown in plan and elevation in Fig. 1, and will serve to illustrate the principles upon which a large class operate. The apparatus consists, first, of a tempering coil for raising the temperature of the incoming air above the freezing point, although in some cases this is dispensed with and steam coils are used for warming the circulating water; second, a spray chamber and tank of galvanized iron, copper or concrete, the former containing a number of spray heads for producing a sheet of water through which the air must pass. In some types, the water merely falls from the ceilings; in others, it is sprayed in thin sheets at right angles to the air currents; while in others, it falls like rain over the edges of troughs at right angles to the air. The trough or reservoir at the bottom is for catching the water after it has served its purpose in washing the air.

The third part of the equipment is an eliminator for removing the water from the air. This is usually con-

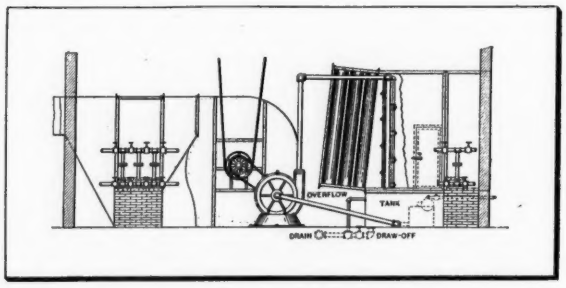


FIG. 2. AIR PURIFYING APPARATUS EMPLOYING INCLINED VERTICAL BAFFLES

structed of galvanized iron or copper and acts upon the same principle as a steam separator; that is, the sudden changes in direction of the air cause the moisture and dirt to catch upon the blades of the eliminator and drain into the tank below.

Efficiency of the apparatus depends largely upon the design and construction of the eliminators, in which the baffles may be either vertical, horizontal, curved, angled or hooked. The water for the spray is circulated under a pressure of 10 to 30 lb., depending upon the type of nozzle used.

As previously stated, certain spray nozzles produce a thin, solid sheet of water; others, a coarse, rain effect; and still others produce a fine spray or mist, discharged in the direction of the air flow through the chamber. It has been found by experience that the air is most thoroughly washed by passing it through the coarser spray, while the cooling effect, which is desirable in summer, is greater with a fine spray or mist. In some cases the 2 effects are combined in the same apparatus by the use of a specially designed nozzle.

The water is circulated by means of a small centrifugal pump, usually driven by an electric motor. The suction of the pump connects with the tank or well at the bottom of the eliminator casing, and the water is used over and over again, until it becomes too dirty to be effective, when it is replaced by fresh, from the city mains. After leaving the eliminator, the air enters the fan and is passed through a secondary heater for raising it to the desired temperature before being delivered to the building.

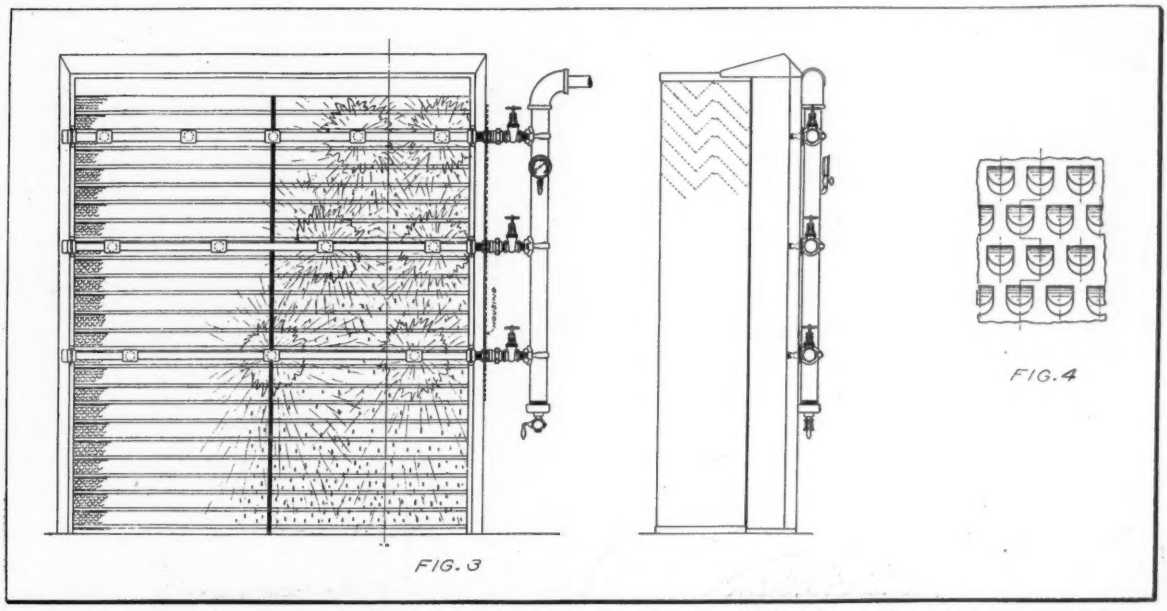


FIG. 3. TYPE OF AIR WASHER AND HUMIDIFIER

FIG. 4. PERFORATIONS IN BLADES OF ELIMINATOR

In Fig. 2 is shown a similar apparatus. In this case the eliminator is made up of vertical blades set at a slight angle, and the pump is driven from the fan shaft instead of by a separate motor.

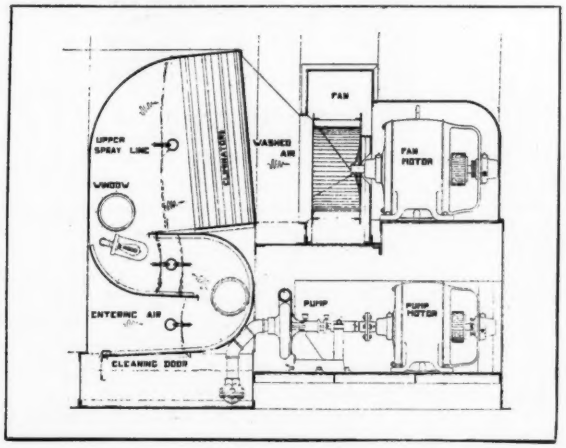


FIG. 5. AIR WASHER, COOLER AND HUMIDIFIER OF THE RAIN TYPE

In practice, however, it is usually considered more desirable to use an independent drive, as in Fig. 1. Views of an air washer and humidifier are shown in Fig. 3, which serve to illustrate in some degree the details of construction of apparatus of this general type.

Figure 4 is a detail of the perforations in the horizontal blades of the eliminator. This apparatus is designed in the larger sizes, over 8 ft. in height, for an air velocity of 500 ft. per min. over the gross area of the eliminator, and for a velocity of 450 in the larger sizes, which, in each case, results in a velocity of about 666 ft. through the free area of the eliminator. The spray nozzles require 4 gal. of water per min. each, under a pressure of 5 lb. per sq. in., and one nozzle is provided for each 3000 cu. ft. per min. The design and arrangement of the nozzles are such as to produce a rain effect with a small expenditure for power, only about 0.012 hp. being required for each 1000 cu. ft. of air per min.

In one make of air washer, a nozzle is used which produces an almost invisible spray. The water is discharged through a 3/32-in. orifice under a 20-lb. pressure, and is broken into a fine spray by the whirling motion given to it as it leaves the nozzle.

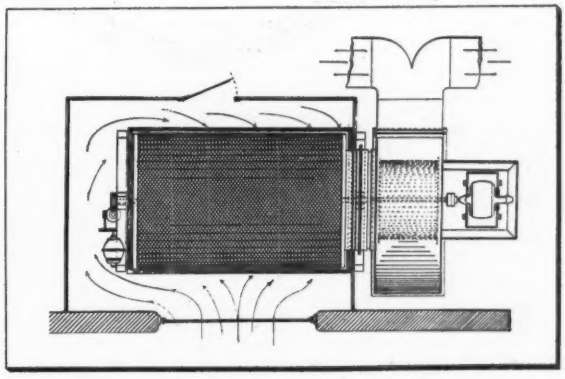


FIG. 6. AIR WASHER OF THE STRAINER TYPE

Two nozzles are provided for each square foot of sectional area, and the air is passed through at a velocity of 400 to 450 ft. per min.

Control of humidity is an important feature in connection with air purifiers of this general type. The humidity in some cases is varied by means of a steam ejector which breaks a certain amount of water into a mist so fine that it will pass by the eliminator, being, in

fact, water vapor. In other cases the humidity is controlled by the temperature of the air in the spray chamber.

For example: Air at 50 deg. will absorb 4 gr. of moisture per cu. ft.; at 70 deg., 8 gr., at which points it becomes saturated for those temperatures. If it is desired to maintain 50 per cent humidity at 70 deg. temperature in a building, it is only necessary that the air in the spray chamber be saturated at a temperature of 50 deg., and afterwards raised to the temperature of the room without any further addition of moisture. In the air washer, cooler, and humidifier, shown in vertical section in Fig. 5, the air, after passing through a tempering coil (not shown), enters the chamber at the bottom and is drawn through 2 complete semicircles within the spray chamber. The water within the casing is thrown in radial sheets by the spray heads, so that it splashes against the curved walls of the air passage, producing the effect of a driving rain and keeping a constant film of water on the surfaces over which the air flows.

Water is delivered to the spray heads under a pressure of about 10 lb., and the makers guarantee to free the air of 95 to 98 per cent of all dust and solid matter in suspension, and to lower the temperature of the air to within 4 to 6 deg. of that of the water used, in the summer.

A washer of a different type is shown in plan in Fig. 6. This consists of a metal framework cylinder, covered with a special linen burlap, woven with 7 strands to the inch. This is enclosed in a chamber, as indicated, and slowly revolves with the lower part in a shallow tank of water, which serves not only to wash off the accumulated dust, but also coats the burlap with a film of water. The air passes into the cylinder through the perimeter, as shown by the arrows, and flows into the fan through an opening in the end.

In general, no eliminator is required. Tempering and reheating coils are used the same as in the other types of washers, although not shown in the cut. In some cases the tempering coil is omitted and the water in the tank heated instead.

The humidity of the entering air is controlled by varying the speed of the washer and the temperature of the water in the tank. A washer of this type, recently installed, has a cylinder 7 ft. in diameter by 10 ft. in length and has a capacity of 20,000 cu. ft. of air per min.

In Fig. 7 is shown an air-washing and cooling fan. Referring to the cut, the filter ring, A, is made up of a number of layers of wire cloth with small spaces between them; K is an eliminator made up of a large number of narrow blades similar to those of a multivane fan; L is a collector ring for catching the water from the eliminator, which is supplied inside the filter ring by a number of spray nozzles, as shown.

In operation, the filter ring, eliminator and collecting ring revolve rapidly within the casing, thus passing the air by centrifugal force through the filter and eliminator into the outer space, from which it flows into the main ventilating duct. The water is removed by the eliminator blades and discharged into the collector ring, from which it passes into the distributing pipe supplying the spray heads, having sufficient momentum to produce the necessary pressure without the use of a special pump.

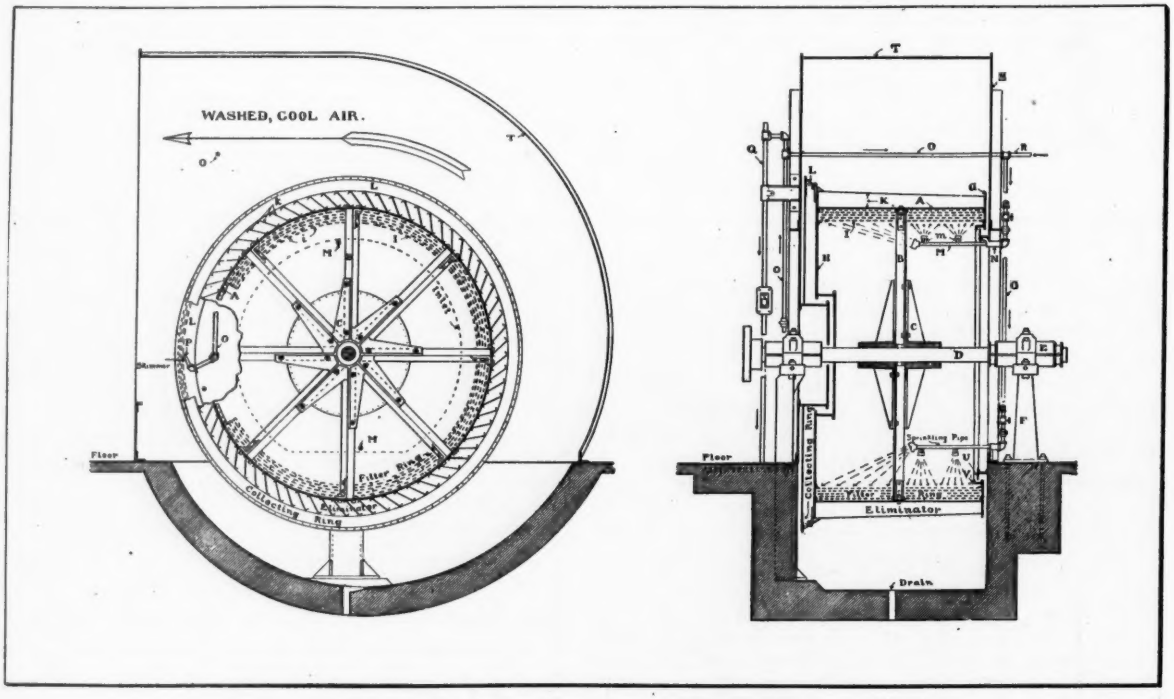


FIG. 7. COMPACT TYPE OF AIR PURIFYING APPARATUS

This device is similar in form and size to a centrifugal fan having the same capacity.

Use of air washers has greatly increased in the past few years and they have now come to be considered an important part of the ventilating equipment in large city buildings. To be effective, they should have sufficient area, so that the air will not pass through at too high a velocity, and great care must be taken in the design of the eliminator to provide proper water collecting surface, and at the same time, not impose too great a resistance upon the fan.

VACUUM HEATING EXPERIENCES

Radiator Valve Troubles, Installing a Heater

By F. R. Daly

By an up-to-date vacuum system I mean the usual 2-pipe system where an automatic valve is used on the radiator which prevents the passage of steam, but at the same time lets water and air pass through to the return line, on which a vacuum or suction is maintained by the vacuum pump. Therefore, the valve or trap that will hold the steam in the radiator, until it is in the form of water and air, is the best trap and the most economical. Any trap or valve that lets steam, air or water through it before it is cool enough to be handled by the vacuum pump, is imperfect.

As a rule, the returns from such traps need the aid of a jet of cooling water before they are in condition to be handled by the pump. By this jet of water heat is wasted, as more water is generally used for cooling than is needed for make-up water. Then there is a surplus of hot water and some of it must go to the sewer, carrying with it heat. If the valves on the radiators would stay closed perfectly tight, until the steam in the radiators had cooled off, and then open and let the water and air into the return line, there would be no hot return water and a cooling jet would not be necessary, as the vacuum pump would easily handle the return water.

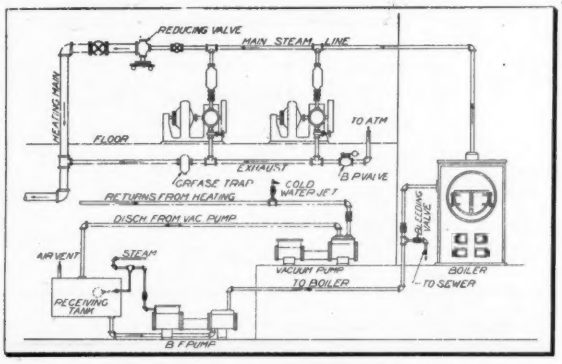


FIG. 1. PIPING OF GRAVITY HEATING SYSTEM CHANGED TO VACUUM SYSTEM

A radiator valve or trap which, at all times, has an opening through it, however small, is to be avoided if you wish to avoid trouble. Enough hot air and steam is drawn through this opening to make the return line almost as hot as the steam main. Of course, we would rather not have this air in the radiator; but, as long as we can't help it, why not leave it there until the heat is out of it before removing it to the return line and diluting the heat that it contains with cold water? I have worked on 3 installations where the removal of air was so continuous that we had to use a big jet of cooling water in the return line in order to get the return water cool enough for the vacuum pumps.

I know of only one heating plant where continuous traps are used where they do not need a jet of cooling water. This is because the buildings heated are so far away from the plant that the return water is cool when it gets back.

The 2 principal parts of a vacuum heating system are the radiator traps and the vacuum pump. When looking for a vacuum pump remember that the air and water you are going to pump are going to be hot. The best vacuum pumps have 16 valves and the poorest only 4 valves in all. I have found that the more valves a pump has, the more chances it has of not leaking. Take a new pump with 16 good valves—when one valve fails the pump is 1/16 gone. Now take a new pump with 4 good valves—when one of these fails the pump is ¼ gone. I am speaking of 2 pumps the same size. The pump with 16 valves would have small valves about 2¼ in. in diameter, while the pump with only 4 valves would need to have them about 5 in. in diameter. The smaller the diameter of a hot water valve, the less likely it is to warp. Large valves may be good for cold water, but for hot water I prefer small valves and plenty of them.

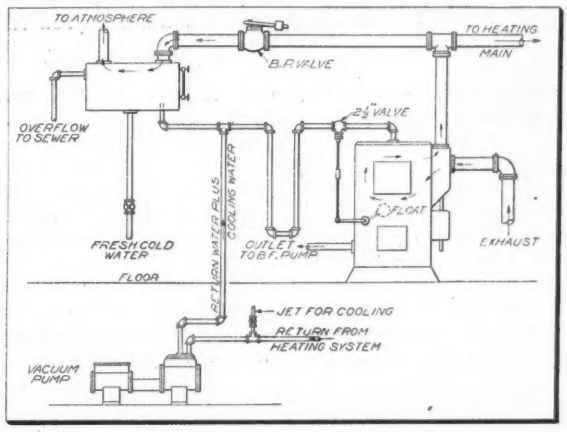


FIG. 2. HEATER PIPING PROPOSED

In one plant we had 13,000 sq. ft. of radiation. It was an old gravity system converted into a vacuum system. The radiation was in 3 different buildings, the farthest being about 500 ft. from the engine room. We used exhaust steam for heating, helped out by live steam. We carried about 1 lb. pressure on the heating main and about 7 in. of vacuum on the return line. The vacuum pump was in the basement under the engine room on a level with the common return from all the buildings, which came to the pump through a tunnel. Figure 1 shows the elevation of piping and location of storage or receiving tank.

The diagram will show how the jet of water was used for cooling the hot return line and how the surplus water was disposed of in the boiler room. The feed-water pump was controlled by the float in receiving tank and had to be left running all the time in order to make room for return water plus cooling water. When the fireman wanted more water in the boiler, he closed the bleeding valve a little; when he was getting too much, he opened the bleeding valve wider, letting more hot water go to the sewer. If the valves on the radiators had held the hot air and steam out of the return line, this waste would have been unnecessary.

We had considerable trouble with oil in our boilers and also in the heating system. We decided to put in a feed-water heater to remove the oil, heat the feed water and act as a receiver. All heater catalogs will tell you to put all the returns from the heating system into the heater. If this is done all the surplus water will overflow out of the heater to the sewer after it is heated. I proposed to get rid of this surplus water before heating it. The water level is maintained in a

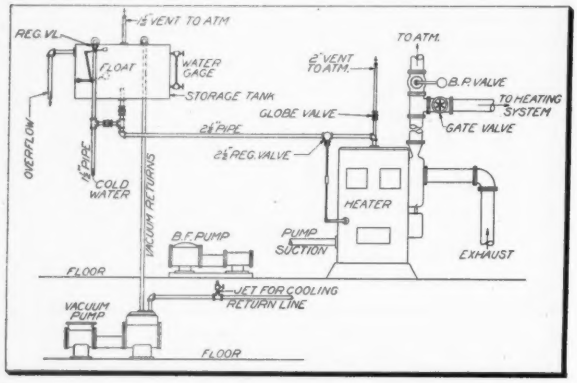


FIG. 3. PIPING RECOMMENDED BY GENERAL AGENTS FOR THE HEATER

heater by the overflow in case it gets too high and by a float-regulated valve which admits fresh water in case the water gets low. This valve, with the heater we were getting, was supposed to be 1¼ in. In the order I told the agents that we wanted a 2½-in. valve instead of the 1¼-in. valve specified. I sent a sketch showing how I proposed connecting up the heater and how I would use the 2½-in. valve.

They immediately wrote back saying that the way I proposed to connect up the heater was not the proper way. They didn't say why, but sent a sketch showing "the right way," which I did not like.

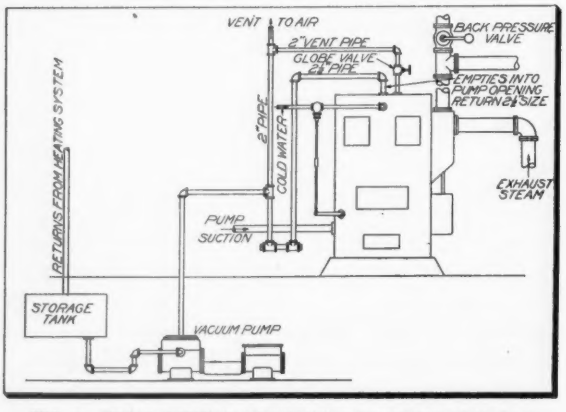


FIG. 4. FINAL SCHEME PRESENTED BY LOCAL CONCERN

I then sent a copy of Fig. 2 to the Chicago firm for whom the local concern is agent. Figure 3 shows their idea of how the heater should be connected. This is a good scheme and quite similar to that which I proposed. In this plan, all the return water goes to the storage tank. I don't believe in putting any water in the storage tank unless the heater is full. The shorter the path from the radiator to the boiler, the better.

In my scheme the water from the vacuum pump goes to the heater direct if the heater needs it, and if it does not, it goes up to the storage tank. If any water happens to be in the storage tank when the return water is not sufficient for the heater, the water in the tank runs down into the heater. The object of a storage tank is to have some place to keep the large amount of water that comes back when all the radiators are first turned on in the morning. Otherwise this water would be wasted.

While the Chicago firm was doing its figuring, I sent complete details to the local office, just to give them an equal chance. The Chicago office sent sketch No. 3 to its agents, and in a few days I received an envelope with sketches 3 and 4.

Figure 4 represents the final effort of the local dealers. In view of the fact that I did my best, as did also the Chicago office, to educate them, I don't see any excuse for them at all. They advised me to use the old gravity tank for a storage tank, but to leave it where it was, down in the basement. You will see in Fig. 4 how they proposed to do this. That

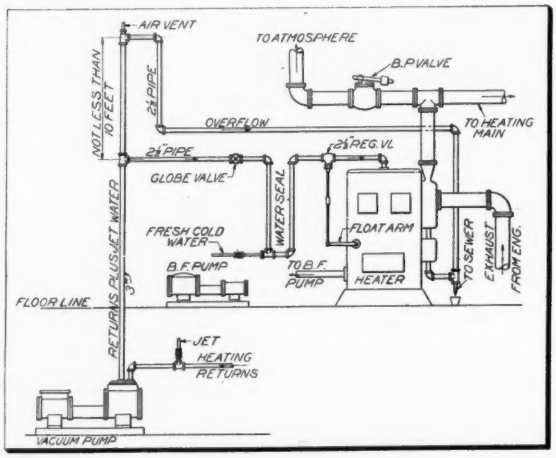


FIG. 5. HEATER PIPING AS INSTALLED

looks more like an enlargement of the return line than a storage tank. But they never did understand why all of the discharge from the vacuum pump should not be put into the heater. As we had never had any serious trouble with our sewer, I did not propose to heat water to flush it with.

All this arguing took time and delayed the order for the heater so that I concluded we wouldn't have time to put the tank out of the basement and up over the heater, so we connected the heater up as shown in Fig. 5. You can see by this sketch that the discharge from the vacuum pump will go to the heater if the regulating valve is open; but if not, water will be raised up until it comes to the overflow pipe, where it goes to the sewer. This overflow should be up high enough to overcome whatever back pressure may be carried on the heater. Water seal should be long enough to prevent pressure of vacuum from taking water out of it. Undoubtedly other engineers have had similar experiences with vacuum systems, heaters and heater people. I consider the feed-water heater the heart of an engine room.

NEVER BEAR MORE than one kind of trouble at a time. Some people bear three—all they have now, all they ever had, and all they expect to have.

KEEPING THE ELEVATOR RUNNING

Automatic Operation of Hydraulic Pumps with Broken-Down Accumulator

By Frank J. Schnaubelt

SOME time ago a piece broke out of a stuffing box of an accumulator cylinder on a hydraulic elevator system, necessitating sending the damaged cylinder to the makers for repairs, and we had to run for about 6 weeks with the pumps direct on the line. The pressure on the system is 1000 lb. and the elevators are of the ram type and used only in the 2-story factory buildings (the high buildings have electric equipment). There are 8 of these elevators in service and the fluctuating nature of the pressure without the accumulator can be imagined.

The service is supplied with one steam pump and one electric pump of 40-hp. capacity. A man was stationed at the pumps, which are in the power house, and controlled the pressure with the throttle of the steam pump and a switch for the electric pump, a lever being extended from the throttle to where the switch was located so as to maneuver easily both pumps as required. The electric pump is normally operated by contacts made by the accumulator in its travel, also

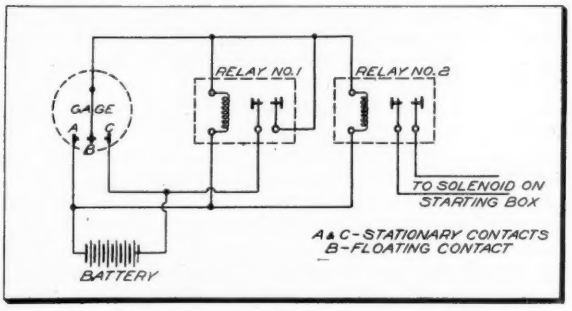


FIG. 1. WIRING SCHEME FOR CONTACTOR GAGE

a cable from the accumulator is suitably brought over to control the steam throttle so that with the accumulator in service no attendant is necessary.

We could not very well spare a man to operate the pumps during the breakdown and immediately started on schemes to make the system self-controlled. The steam pump, of course, is automatic to a small extent, for if given a small amount of steam and no elevators operating, it will run very slow, as the pressure builds up and will not raise the relief valve very often before some elevator is again used. It will also speed up considerably, as water is used as the pressure drops; hence there is much less back pressure at the water end. The limited amount of steam that can be given it, however, will be insufficient for caring for more than one elevator and even then the pressure will drop from 1000 to 400 and even 200 lb.

The first and simplest scheme, then, was to use a contactor gage for the solenoid operating the electric motor as the accumulator had done. In the first gage used the Bourden tube was fitted with an extension, through the case, of about 12 in., on the end of which the contactor was placed. This was entirely out of the question on account of the jarring of the steam pump at high speed.

Then we used the gage which we had made for a 1000-lb. air line and in which the moving contact, B (Fig. 1), did not float between the stationary contacts, A and C, but would remain in contact with one until the pressure change, for which it was adjusted, would move it, when it would travel to the other contact and remain there. For most operations this is more desirable than just to make 2 contacts for the gage pointer to touch in its travel.

The first trial was made by connecting the solenoid of the starting box direct to the gage. When the pressure ran up and the gage broke the contact, the arc remained there and kept the solenoid in and the motor running, which, of course, would not do. The distance of travel was too small to extinguish the arc, especially as it was enclosed by the glass cover of the gage. That meant, of course, to use a relay.

A 5-ohm telegraph (pony) relay was soon at hand and in service, the gage operating the relay with a few cells of battery and the relay closing the motor solenoid.

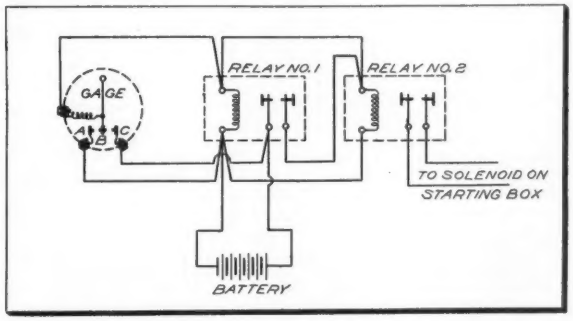


FIG. 2. ACTUAL WIRING OF GAGE AND RELAYS

This ran along nicely, but it was soon discovered that it was imperfect, not in itself, but by reason of the heavy jarring of the steam pump (transmitted through the water to the whole line), which would open and close the gage contacts rapidly, the relay contacts and the motor board solenoids and switches doing likewise. We wouldn't have cared much for the performance of the gage and relay, if the switches on the board had behaved. As it was, the bombardment was sometimes terrific and the motor had to take it all in. Sometimes the first solenoid switch would open and before the motor had stopped (its running as a generator keeping the last solenoid switch in until the motor stopped), would throw in again before the last switches had opened, throwing full 230 volts on the motor and blowing the main fuses.

These operations, it must be understood, occurred much faster than it takes to tell about them, the relay and gage working much like a Tirrell regulator. I then devised the scheme illustrated, using 2 relays, and was preparing to put them in when the chief engineer came and said the equipment, that was in, wouldn't do very much longer or the motor and board would have to go to the hospital. I informed him that the next operation would quiet things down materially and the operator would be dispensed with, which came true as predicted.

The wiring of the relays, though simple, required a little thinking for its production, and it wasn't done until a half-dozen sketches had been made.

The scheme was as follows: The gage makes contact (B to C) and closes the relays, the contacts of the first relay then keeping the circuit closed, irrespective of the jarring of the gage contacts; the second relay contacts close the motor solenoid switch, when the pressure goes up, the gage making the other contact (B to A) short-circuit the coils of the relays and they both release. And you would have the short circuit on your battery, but the opening of contacts of relay No. 1 opens the short circuit. Six cells were used, 2 parallel rows of 3 in series, and after 3 days, when weak, they would do another day wired all in series. Eventually, however, I used the 230-volt service through a 500-ohm resistance.

From Fig. 1 it may perhaps appear as if there were many splices to make, but those of you who are electricians will know that the actual wiring is done as shown in Fig. 2. After a few days a further improvement was made by placing a reducing valve in the steam line for the steam pump, so set that the pressure was not sufficient to produce more than 1000 lb. at the water end. As the water pressure drops, the reducing valve supplies all the steam necessary; in fact, the steam had to be throttled some to prevent the pump from hammering too much, due to high speed.

The gage for the electric pump was then set to operate when the steam pump started to speed up a little, and very often the steam pump did not require the help of the other at all. At times, however, the requirements were so severe that the electric pump operated upwards of 500 times a day.

ENGINES FOR HIGH SPEED

Suitability of Corliss, 4-Valve and Single-Valve Types

By A. M. Morse

DURING the past decade, a number of designers and builders of reciprocating engines have been running a race with each other in their efforts to product a 4-valve engine which would cost less money and give performance and economy equal to or better than the standard type of Corliss engine with its characteristic releasing gear, with dashpot and quick closure admission valves.

Builders of slide valve and high speed automatic engines having noted the diminishing trade on these types of steam engines, have gone into the building of engines having 4 cylindrical valves, the admission and exhaust valves being actuated by separate eccentrics, the admission valves operated by various types of valve motions from plain drag cranks to multiple links and cams both open and enclosed and with a shaft governor to give the necessary variable travel to the admission valves. These engines have been called "four-valve" "Corliss valve," "high-speed Corliss," "nonreleasing Corliss," etc. Some of them have developed to fill a certain place in power plant equipment; others have been relegated to the scrap pile, after a short, checkered and unprofitable career. The best of this type of engine approach the characteristic efficiency and performance of the regular Corliss engines with their essential releasing valve gear and quick closure of the admission valves.

Now, looking at the matter from the angle of the builders of regular Corliss engines, one discovers that the progressive ones have been busy refining the engine as a whole, providing for the changing conditions of service, perfecting the valve gear to run at higher speeds than formerly, and to give greater efficiency and better all-around performance than attainable with the older construction. Some of these new designs have resulted in remarkable showings, far better than possible with the older types.

As a matter of record, some of the representative Corliss engine builders have within the past few years tried out designs of their own engines with a substitution of a nondetaching valve gear for the standard Corliss gear, using, necessarily, some form of shaft governor. It is naturally to be supposed that such builders with their wide experience in Corliss engine practice would be eminently fitted to judge as to the comparative merits of the 2 types of engines, and the fact that they have largely discontinued the building of nonreleasing gear engines, and have concentrated on further improvement and refinement of the releasing gear, should be a guide as to the comparative merits of the 2 types.

It sometimes happens, especially in remodeling old plants on valuable real estate, where new units are to be installed and floor space is limited, that engineers and owners are forced to select short stroke, short connected engines, even at a sacrifice of the best performance, high economy and maximum durability of the unit; such conditions often apply for units ranging in size from say 150-hp., 100-kw., up to 300-hp., 200-kw., at speeds around 200 r.p.m., and let it be said here the writer believes that higher speeds than 200 with any form of nonreleasing valve gear should be strongly discouraged, as repairs and unreliability increase rapidly with the speed. Furthermore one should be alive to the fact that rotative speeds of 150 to 175 r.p.m. are practical in some forms of Corliss engines with releasing valve gear. Surely these engines are to be preferred, if the available space will take in the unit even with a little crowding, and of course provided that the buyer and owner can afford to spend the necessary money to get the best. This is especially true for sizes, from about 300 hp. up to 1200 hp., and when smaller units are being considered, careful attention should be given to the well designed and balanced, high-speed, shaft-governed single-valve engine either single or compound, which is favorable to high speed.

In conclusion, while the fact is evident that the field of the reciprocating engine is being contracted, on the one hand by turbo-generators for very large units and by internal combustion engines for medium and smaller units, and on the other hand by the insistent reaching out of the central stations in their relentless and somewhat unscrupulous fight against isolated plants, there still remains a legitimate and liberal field for high efficiency reciprocating steam engines. The old law of the survival of the fittest will, however, automatically eliminate the undesirable types of engines.

To repeat, refined and perfected releasing gear engines are available, with Corliss, gridiron or poppet valves, ranging in sizes from 1200 to 250 hp. and for rotative speeds around 150 r.p.m., and piston speeds of 750 to 1000 ft. per min. For smaller sizes, there are carefully balanced automatic engines with simple valve gear suitable for speeds of 250 to 375 r.p.m. and piston speed about 600 ft. per min.

AIR EJECTOR FOR CONDENSERS

To Replace the Dry Vacuum Pump by Action of Steam Jets

MDELAPORT, of the Breguet Works in France, has perfected a device called the Ejectair which, by means of 2 steam jets removes air from the jet or surface condenser for producing low vacuum. The first jet at A draws air and vapor from the condenser and forces them into chamber D, where the vapor is condensed by a water spray, and the air is drawn out by ejector jet E. The water is removed by a specially shaped pipe F which permits a difference of pressure between chambers D and C, allows

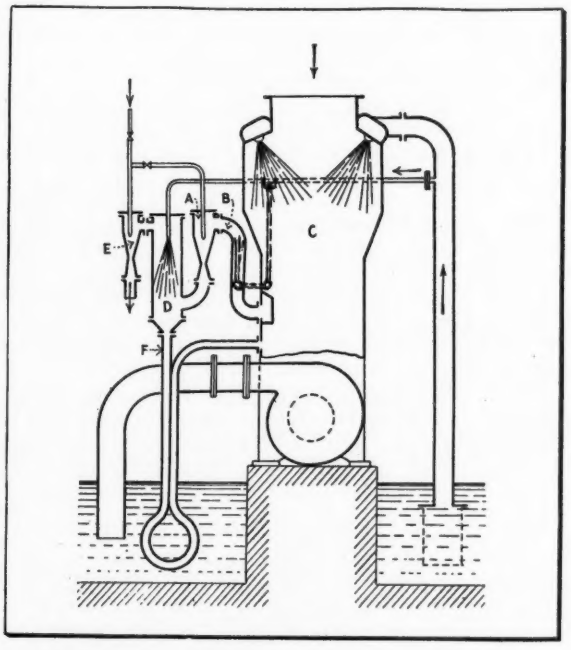


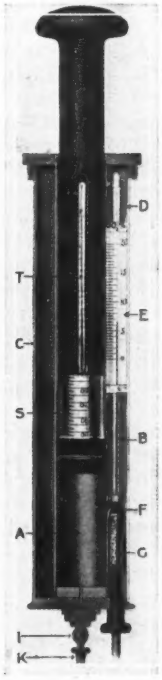
DIAGRAM OF A CONDENSER USING AN AIR EJECTOR

water to flow into C but prevents flow of air. A water jet into pipe B condenses much of the vapor in the mixture, thus allowing the jet A to handle a greater volume of air. All steam from the ejectors passes to the feed water tank. Starting is accomplished by opening the steam valves, no priming being necessary, and no attention is required after starting as variations in steam pressure do not materially affect the vacuum formed by the ejectair.

PORTABLE CARBON DIOXIDE ANALYZER

Dry Chemicals Used in Meter Which Employs Thermoscopic Principles

EVERYONE concerned in the production of power from coal appreciates the value of a knowledge of combustion processes in a furnace. As the percentage of carbon dioxide in the furnace gases of a steam boiler rises, the waste of coal falls and it is just as important to control the combustion of fuel by determining the amount of carbon dioxide in the waste gases as it is to indicate the engines in order to secure a good overall efficiency of the power plant. When the waste gases contain about 12 per cent of carbon dioxide the coal is being burned at about its best efficiency and therefore the need arises for means to determine the percentage of carbon dioxide present. Some of the measuring devices which have been used, although most valuable especially in larger power houses, for indicating and recording carbon dioxide analyses, have the disadvantage that they are large and not of a portable character, and in some instances have a rather high first cost. It is, therefore, useful to refer to the portable indicator which is illustrated in the figure, this being patented and manufactured by the Underfeed Stoker Co., Ltd., of London, England.



FOREIGN CARBON DIOXIDE ANALYZER

It will be seen that the instrument which is of a simple and portable description consists of 3 essential parts. The first of these is the cylinder fitted with a plunger for drawing a measured quantity of the mixture and subsequently passing it through the second essential feature, which is a cartridge shaped receptacle containing pulverized caustic soda. In this a heat reaction occurs. Thirdly, there is the thermometer with its bulb constructed so as to surround or jacket the cartridge, and in this way the heat of the reaction is imparted to the mercury, the amount of its expansion which is dependent on the percentage of carbon dioxide present, being then determined on a movable scale. Referring to the figure, A is a cylinder fitted with a piston and cup leathers. The thermometer B is suitably mounted on the cylinder, the whole being enclosed by an outer cylindrical metal jacket C, which is slotted so as to show the stem of the thermometer at D. A movable scale E calibrated in percentages of carbon dioxide is arranged so as to slide in the slot. G is a cartridge of thin sheet metal containing the pulverized caustic soda and is shown jacketed by the thermometer bulb F in position for an analysis. Connection is made between the cylinder and cartridge

by means of the rubber tube K attached to the tap I.

When the carbon dioxide (either pure or in admixture with air) is brought into contact with caustic soda a chemical reaction takes place and heat is evolved, the amount of which is proportional to the quantity of carbon dioxide in the mixture. If then the measured quantity of the gas mixture which has to be analyzed is brought into contact with the caustic soda and providing that the amount of the caustic soda is somewhat more than sufficient to absorb all the carbon dioxide present, it then only becomes necessary to measure the heat evolved in order to obtain a measure of the carbon dioxide in the mixture. It will be seen that this apparatus, is therefore a thermoscope especially arranged to carry out these operations.

In order to make the analysis, a cartridge is taken and pricked at each end to allow the gases to flow through. It is then attached to the rubber connection K and inserted in the thermometer bulb F. A sample of gas is then drawn into the cylinder and in order to correct the volume of the gas taken into the cylinder for varying room temperatures, the length of travel of the piston is regulated according to the temperature as shown on the thermometer T, by the scale engraved on the piston rod S. The free end of the rubber tube is connected to the cylinder nozzle, the zero of the movable scale is adjusted opposite the top of the mercury column of the themometer and the piston rod is depressed. The gas mixture flows through the cartridge, heat is generated, the mercury rises and the percentage of carbon dioxide can be read from the scale opposite the highest point reached by the rising column.

There are certain advantages in connection with the use of an instrument of this type which can be emphasized. The first of these is that the process is dry; there are no liquids or chemical solutions to be handled and hence the process is reduced to such elements of simplicity that it can be safely placed in the hands of those who are not usually accustomed to the handling of chemical apparatus. The present form is valuable to even the smallest power plant, on account of the important bearing which the determination of the percentage of carbon dioxide bears to the efficient carrying out of proper combustion processes.

WHAT THE YOUNG ENGINEER DID

By M. J. Conlon

WHEN there is a place open the question often arises, Can every fellow who calls himself an engineer make good? That's the question that can only be answered by a trial, and quite frequently the answer will be in the negative.

In a small but prosperous concern which had grown rapidly there was need for more room and more machinery to keep pace with the demands for goods, so the old regime which had done good work for 18 yr. and then grown too small was thrown out and a good type of 4-valve engine purchased and installed. The engineer who had grown gray in the business felt that he had worked long enough to retire so a new man was needed, and several were looking for the job, but the "kid engineer" with a lot of friends, and good, or at least high sounding, recommendation was the one who landed on his feet.

Now, this kid engineer had the appearance of a willing worker, but never a 4-valve engine had he run before, and at night and noon he had 5 or 6 husky fellows around the engine room with a big lever like a telegraph pole to pull her off center, and a dog on the rim of the flywheel to give a pry. The starting bar bothered him and he was slow in catching on, and one time when the men had worked the engine off the head end center he opened the crank end valve with the throttle partly opened, and as the men didn't have time to get the lever back out of the way of the dog, one fellow who was on the end of the lever was pitched up against the wheel. He drew a broken nose and a cut forehead and all of the men got a bad scare.

It taught the fellows a lesson forever, and after that everyone who was called on to put the engine off center was mighty careful.

It was the kid's hobby to be always monkeying with some part of the engine and when it wasn't the valve gear it was the crossheads or the main bearings, which he kept everlastingly taking up until he finally got it hot on several occasions and also got the crosshead shoes overheated.

Of course, he was always right and the blame was always on somebody else, or on the kind of babbit the engine builders used, or on the bad machine work, or on the way the engine was lined up by the erecting man; but the kid whose name was Jim finally got himself in so bad and so often that the superintendent began to have doubt as to his ability and one day called for a set of indicator cards with full load on the engine and also with friction load. The coal pile was going faster than ever before and so many changes had been made in the valve gear that the superintendent felt sure something was wrong.

Well, when Jim got that card, it didn't bear even a family resemblance to the one taken by the man who erected the engine, and as the friction card was bigger than that when the engine was first set up, the only excuse Jim could offer was that there was a "bug" in the crosshead, and when he got that out he would show a smaller friction card. This didn't satisfy the "super," however, and he sent the cards along to the builders, and asked them to prescribe what would give a better result for the amount of coal burned.

It so happened that the erecting man was back in the shop and he was sent post haste to investigate and put the engine right again. After a short examination he said that the engine had to be thoroughly overhauled; it was out of line, the valve was not properly set, and things were in bad shape generally.

This was bad news, but the superintendent took it with as good grace as possible, ordered the plant shut down, and gave the erecting man all the help he needed, while he proceeded to undo the kid's adjustments and valve setting. Before they got through the engine was lined up, the main bearing and crosshead shoes had been rebabbited, the eccentric was put back on the original mark, and when she started up all was well again. The cards taken with the friction showed a decided improvement, and the kid engineer with his long string of recommendations was told to trot back to the sawmill, whence he came, and take his recommendations all with him.

So the moral of this little yarn is that it isn't always necessary to be tightening or fitting or fixing over an engine, and the notion some men have that they are working so long as they are doing this is not right. I like to run a bearing as tight as it will stand without an excess of oil and not cause too much friction; the same with the guides and the piston; and to keep the engine in line, with the piston in the center of the cylinder, and the crosshead adjusted to keep the piston rod level.

Electrical Machinery and Appliances

For Generating, Transmitting and Using Current

PRACTICAL ELECTRICAL ENGINEERING

Generator and Motor Connections; Brush-Holder Rigging, Brush Holders and Brushes; Types of Armature Windings

By Norman G. Meade

IN Fig. 1 is shown the common type of connections for direct-current generators and motors with compound winding. Enameled slate or finished marble blocks support brass plates to which the connecting lugs are bolted.

The connection block at the left-hand side of the cut is assumed to be positive and connects to the positive bushes by means of flexible leads soldered into lugs. The second lug serves to connect the cables running from the positive lead to the switchboard.

Five sets of cables are connected to the right-hand terminal block; the negative brush holder lead, equalizer and negative leads to switchboard and the 2 connections of the series or compound winding. In addition, there is the series shunt attached at each end of the connection block to extension from the brass plates to which the various leads are connected. It will be noted that

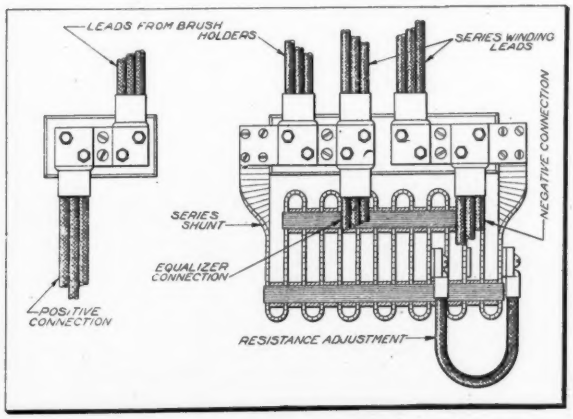


FIG. 1. DETAILS OF COMPOUND GENERATOR OR MOTOR TERMINALS

there are 2 plates for the lugs' attachment, which are separated on the block, and the series shunt is connected in such a manner that it carries or shunts part of the current that would otherwise pass through the series winding. The function of the series shunt, which generally consists of laminated German silver loops insulated and bound together, has already been explained in a previous article. A suitable adjustment is generally provided to vary the resistance of the series shunt; one type is shown in Fig. 1, which consists of a short length of flexible cable provided with lugs which can be attached to 2 of several suitable projections on the shunt's loops, thereby cutting out one or more sections.

Brush Holders and Brushes

IN Fig. 2 is shown a common type of brush-holder rigging for a 4-polar machine. The yoke is split and clamps over a projecting sleeve on the commutator of the front bearing and can be rocked backward and forward by means of the handle. The position and the negative brushes are connected by insulated copper connectors; to one end of each commutator, clamped by means of the brush-holder stud, is attached the brush-holder leads.

Figure 2 also shows a cross-sectional view of the same brush-holder rigging in which A is a brush-holder stud; B is a shoulder attached to the stud; C, D and E, insulating washers and bushings; F and H, brass or bronze washers; G, copper connector for connecting brushes of like polarity; I, brush-holder lead, and J, clamping nut on brush-holder stud.

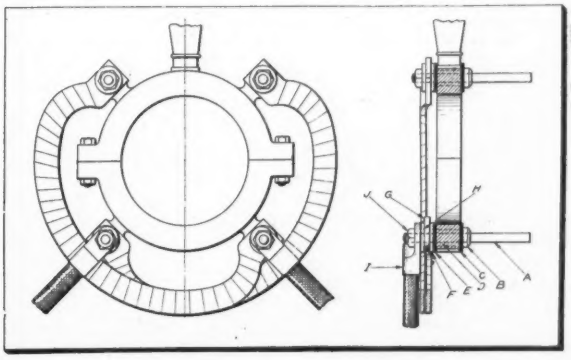


FIG. 2. COMMON TYPE OF BRUSH-HOLDER RIGGING

There are, in general, 2 principal types of brush holders, the box type, shown in Fig. 5, and the reaction type, illustrated in Fig. 6; they use respectively the brushes shown in Figs. 3 and 4. Carbon, graphite or a combination of 2 or more similar materials are used, practically to the exclusion of all other materials for brushes on modern machines. With the box-type brush holder the brush moves freely up and down in the box A, Fig. 5, so that to relieve the spring, F, from carrying undue current, causing overheating. What is known as a pigtail, E, is attached to both brush B and the holder arm, as indicated at I and D. Slots C in the box A, allow the pigtail connector and its retaining screw to move upward and downward without causing the brush to bind. An

adjusting stud, H, with its nut, G, permits of a wide range of pressure by the spring, F, on the brush, B; the complete holder is clamped on the stud at J.

In the reaction type of brush holder no pigtail is required, as the brush, B, is pressed tightly against the holder, A, by the lever, G; this lever is given tension by a coiled spring, E, about a sleeve, D, which moves freely on the brush-holder stem, C. G is a series of notches for receiving the spring projection, H, by means of which the spring tension is governed.

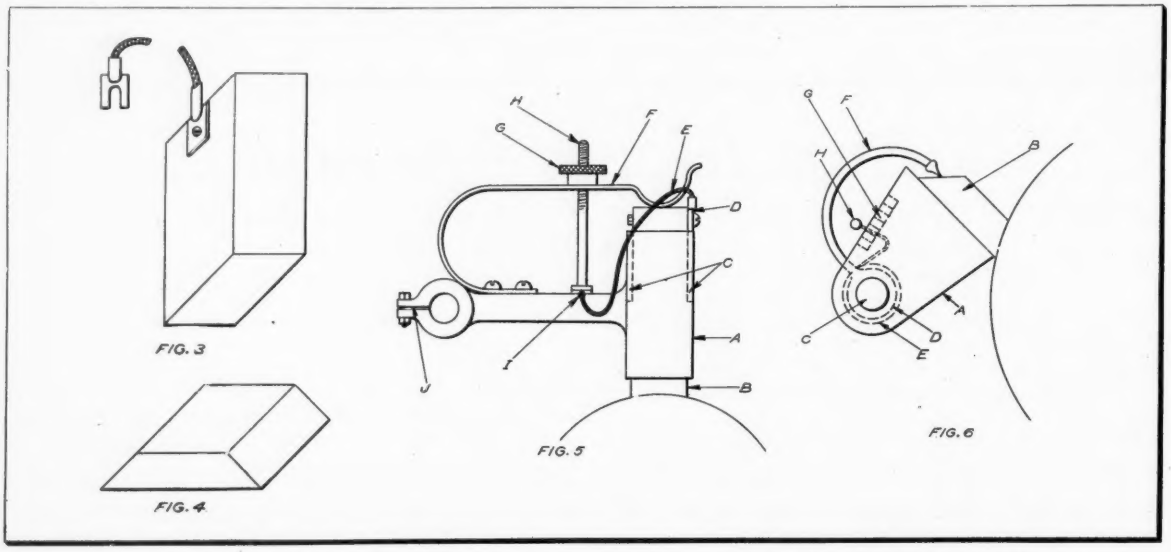


FIG. 3. BRUSH FOR BOX TYPE HOLDER
FIG. 4. BRUSH USED IN REACTION TYPE HOLDER

FIG. 5. BOX TYPE BRUSH HOLDER
FIG. 6. REACTION TYPE BRUSH HOLDER

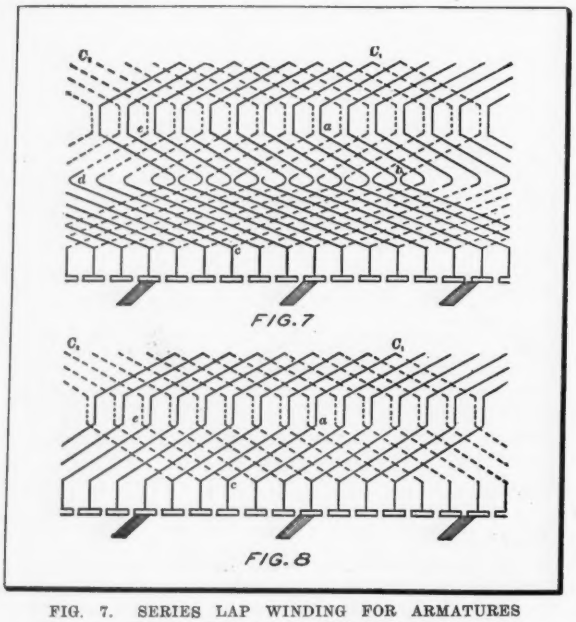


FIG. 7. SERIES LAP WINDING FOR ARMATURES
FIG. 8. SERIES WAVE WINDING FOR ARMATURES

Where single-turn coils are used in machines of large capacity and are open at d and e, it is possible to combine the end connections and the cross connection; this is accomplished by connecting a of coil C_1 through c to e in coil C_2, a c e, Fig. 8, replacing a b c d e, in Fig. 7. Single-turn coil series windings only, can utilize the wave form

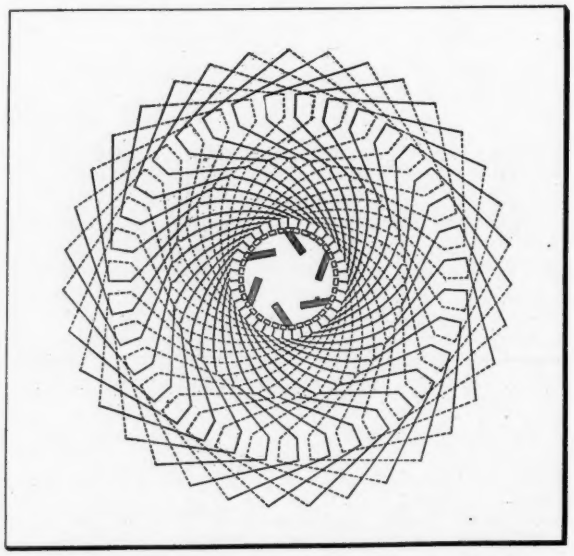


FIG. 9. CIRCULAR DIAGRAM OF SERIES LAP WINDING

Armature Windings

ARMATURE windings with their respective modifications are divided into 2 general groups or classes: series wound and multiple wound. The series winding may consist of 2 forms, known as series lap winding and series wave winding; developments on the 2 latter types are shown in Figs. 7 and 8. In the former, corresponding positions under the poles of same polarity are occupied by coils, C_1 and C_2. Cross connection is made from the end connection, a b, of coil, C_1, to the end connection, d e, of coil, C_2, by cross connection, b c and d c.

of winding; where there is more than one turn per coil, the lap winding must be used. In multiple wound armatures the current passes from one coil to the next adjacent coil, but in series windings it passes through all coils having relative positions with poles of like polarity to the coil next to the first coil. Two sets of brushes,

regardless of the number of poles, can be used or as many sets of brushes as poles may be employed.

Figures 9 and 10 show a ring or circular diagram of a lap-wound and of a wave-wound series armature, having 35 coils and an equal number of commutator segments. Owing to the number of coils, they are slightly

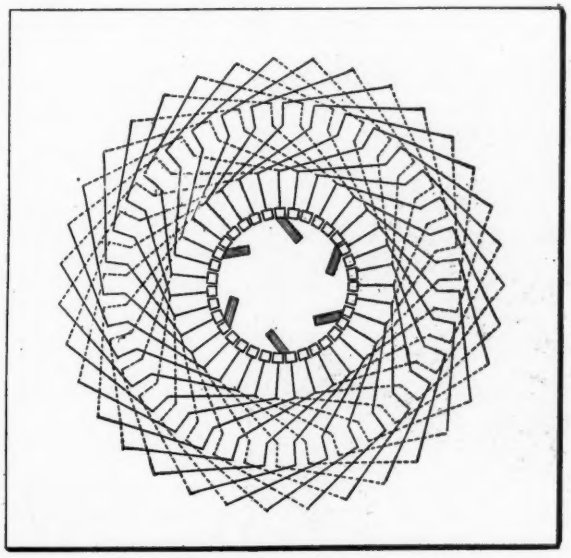


FIG. 10. CIRCULAR DIAGRAM OF SERIES WAVE WINDING

displaced from each other in the relative pitch, so that the current leads into the next coil to the first one after having passed all of the poles.

Figure 11 shows a multiple full-pitch winding for a 6-pole machine in which the coils are connected in closed circuit all around the armature; the commutator is con-

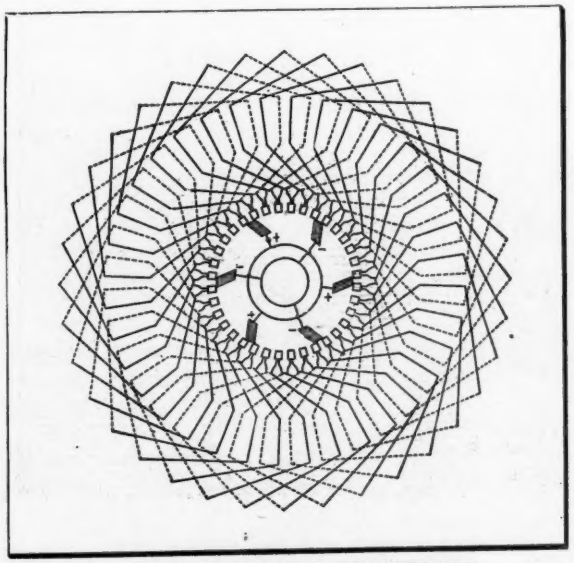


FIG. 11. MULTIPLE FULL-PITCH WINDING

nected to adjacent armature coil connections. In the figure, full lines indicate one side of the coil and dotted lines the other side. As many sets of brush holders as there are poles are required with a multiple-wound machine.

ELECTRIC DRIVE FOR REFRIGERATING MACHINERY

Advantages of Motor Drive for Compressors, Size Motor Required for a Given Capacity and Some Figures from Actual Plants in Operation

IN a recent bulletin from its industrial department, the Westinghouse Electric & Mfg. Co. gives an interesting discussion of the application of electric drive for refrigerating and ice making machinery. Plants are divided into 2 classes, small and large, the dividing line being placed roughly at 10 tons of refrigeration. Electric drive may be used in either class and in any case implies the use of central station power, as it is evidently not economical where refrigerating machinery is installed in a steam plant to generate current in a steam engine unit and apply it in the same room to the driving of a compressor.

Advantages, as given for the electrically operated plants, are that the first cost is considerably less because the motor costs less than an engine and no boilers are necessary in the compressor plant. The space required for an electrically driven plant is less than for a steam plant, less attendance is required, and the operation of the compressor can even be made automatic. The compressor and motor can be located near to the point where refrigeration is required, even in a residence district, because of the quiet operation of the machinery, thus reducing the heat losses. For ice plants in the residence districts this means a reduced delivery haul, also, which may have a large effect on the profits of the business.

Where it is desired to use distilled water, in some cases this is obtained by means of multiple effect evaporators and in other cases water from a heating system is available. In most instances, however, the use of raw water is possible and will have an economy over the use of distilled water.

When using electric drive, it is possible to obtain accurately the cost of power and thus leaks in production can be readily detected, such leaks coming from careless operation, deterioration of the apparatus or variation in the temperature of the condensing water.

Small Plants

THE advantages of electric drive for small plants are the same as for large ones but in greater degree since there are many places where an electrically driven plant can be used, but a steam plant would be an impossibility. Where the power supply is direct current, the motor should preferably be compound wound and, if it is desired to vary the speed of the compressor according to the seasons, a motor permitting a speed range of at least 2 to 1 should be purchased, the speed changes being obtained by field control and not by the use of resistance in the armature circuits. For alternating current, either squirrel cage motors or slip ring motors are available. The squirrel cage, from its extreme simplicity, is generally preferable, if speed change is not required, and if there are no limitations from the central station on the starting current that may be drawn. If speed change or limited starting current obtains, the slip ring motor should be used; also, this type is better adapted for automatic control.

Electrical energy required per ton of ice varies from 45 to 65 kw.-hr., according to conditons of manufacture, and the size of motor for a given compressor can be determined from the curves given in Fig. 3.

Actual Cost

IN a plant which makes raw water ice and supplies cold storage, the capacity is 195 tons refrigeration in 24 hr., ⅓ being used for cold storage and ⅔ for ice manufacture. The ice is made on the plate system, direct expansion and flooded system of coils being used, and comes in plates 17½ ft. long, 8½ ft. wide and a foot thick, the tanks providing for making

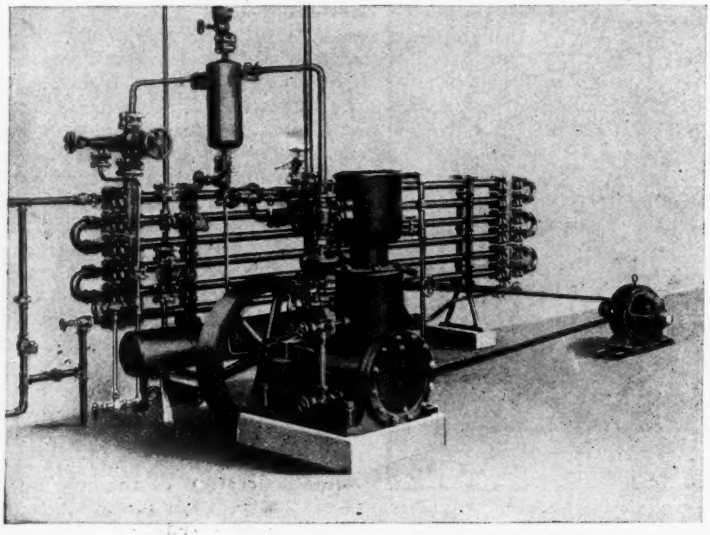


FIG. 1. REFRIGERATING MACHINE DRIVEN BY A 10-HP. DIRECT-CURRENT MOTOR

96 of these plates at once. Alternating currents are supplied, 2 phase, 2000 volts, 60 cycles, for 375 hp. of induction motors, and direct current at 225 volts for 65 hp. of direct-current motors. Compressed air is used for agitating the water to give clear ice. The

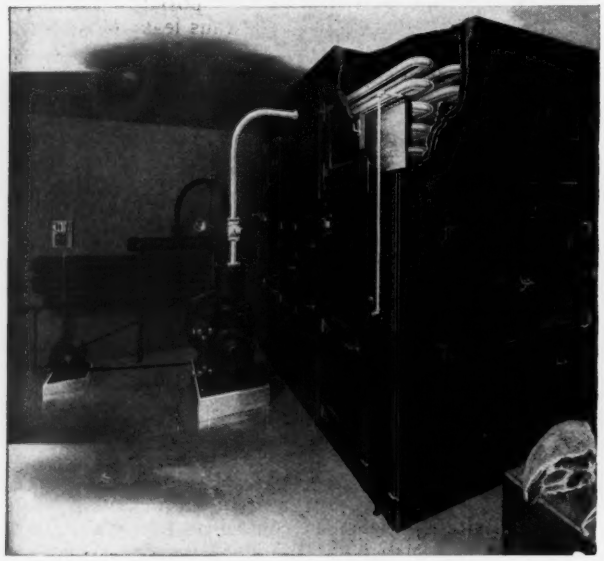


FIG. 2. MOTOR DRIVEN REFRIGERATING PLANT FOR HANDLING MEAT

induction motors are used for driving the ammonia compressors, each unit being a 125-hp. slip ring induction motor, connected by rope drive to a 65-ton ammonia compressor which operates from 25 lb. back pressure to 120 lb. condensing pressure. The motor runs at 435 r.p.m. and has a sheave 24 by 18 in., the sheave on the compressor being 14 ft. diameter with a rim 18 in. wide and 3 in. thick, and carrying 9 1¼-in. ropes. Series wound, direct-current motors are used for operating the cranes and hoists, and shunt wound motors for tripping mechanism, drag conveyors, centrifugal pump, and a 12 by 12-in., 2-cylinder air compressor which supplies air at 10 lb. pressure.

In another plant which makes raw water ice on the can system, the maximum capacity is 68 tons in 24 hr., 2 tanks being provided, each holding 450, 300-lb. cans, and a storage capacity of 750 tons of ice being maintained at 26 deg. F. All motors are of squirrel

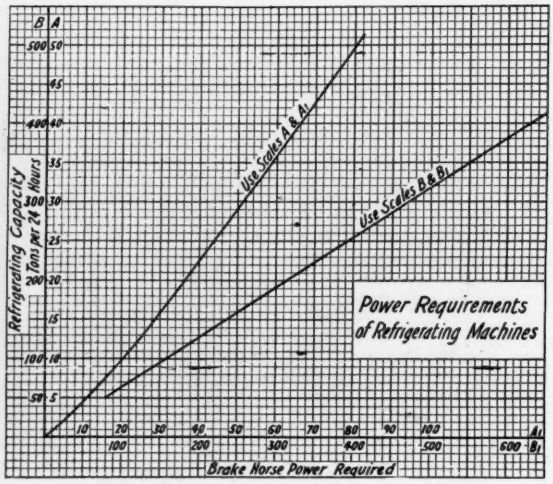

Refrigerating Capacity Tons per 24 Hours
Use Scales A & A1
Use Scales B & B1
Power Requirements of Refrigerating Machines
Brake Horse Power Required

FIG. 3. CURVE FOR DETERMINING THE HORSEPOWER OF MOTORS TO DRIVE REFRIGERATING COMPRESSORS

The upper curve is for compressors of 50 hp. and smaller; the lower curve for large machines. For example, a 30-ton compressor requires a 52-hp. motor; a 300-ton compressor requires a 470-hp. motor. When the ice-making capacity of the compressor is given, the motor horsepower required will in general be about double the figures given in the curve.

cage induction type, the total equipment aggregating 210 hp. and taking 3-phase current, 2200 volts, 60 cycles. A 150-hp. motor is belted to a 2-cylinder, 12 by 24-in. horizontal, double-acting ammonia compressor with rated capacity of 100 tons refrigeration in 24 hr., operating from 19 lb. back pressure to 185 lb. head pressure, the motor running at 495 r.p.m., and the compressor at 68 r.p.m. Smaller motors are in use as follows: A 5-hp. to drive a 2-blade, propeller type agitator in the brine tank; a 5-hp. to drive 2 4-in. centrifugal brine circulating pumps; a 5-hp. to drive an 8 by 8-in. single cylinder air compressor supplying air at 50 lb. pressure for hoists; 2 5-hp. for positive blowers in duplicate units for supplying air to agitate water in the cans; 2 5-hp. motors to drive 2 2½-in. centrifugal pumps in series to raise water from the well to the storage tank against a total head of 100 ft.; a 20-hp. motor to operate a 750-ft, single chain ice conveyor on the loading platform and a 5-hp. motor to operate an ice elevator from the storage room to the loading platform.

In 2 plants for handling meat, squirrel cage, induction motors are used, the current in each case being 3 phase, 220 volts, 60 cycles. In the first a temperature of 40 deg. F. is maintained in a 15 by 12 by 8-ft. refrigerator, the equipment being a 5-hp. motor belted to a 2-ton ice machine working from a back pressure of 15 lb. to a head pressure of 180 lb. In the second a temperature of 33 deg. F. is maintained in a meat storage containing 94,000 cu. ft., and the equipment consists of a 50-hp. motor belted through a countershaft to a single cylinder ammonia compressor of 20 tons refrigeration capacity, working from 10 lb. back pressure to 130 lb. head pressure; a 10-hp. motor belted through a shaft to a deep well pump, operating against a total head of 165 ft.; and a 5-hp. motor belted to a single stage centrifugal pump used for brine circulation and with capacity of 250 gal. a minute operating against a total head of 24 ft.

SAM'L EATON, "TATER-CAR" FIREMAN

By Chas. F. Able

WE were just settled down to "bucking the peak" one evening, when the boiler-room door opened and what appeared to be an ordinary specimen of the "genus hobo" stood framed in the doorway as if undecided whether it was best to enter. As the chill of the cold, wintry draft struck Bob, the nearest stoker, he paused in the task of barring open the fire long enough to shout savagely that familiar cold weather admonition, "Shut that door!"

Calmly accepting this as an invitation to enter, the stranger stepped inside and carefully closed the door. He then proceeded to adapt himself to the change of temperature. First, the bright-red mittens were removed and tucked into the pockets of the heavy ulster; next, the strings of the ear-laps of the big fur cap were untied from under his chin and the ends left dangling; the great coat was next removed and there stood revealed a sight which caused the face of even the busiest to relax in a smile. Tall and lanky, the sleeves of his jacket much too short, disclosing a considerable length of big, brawny wrist; pant-legs ending about 3 in. above the tops of rough, heavy shoes; the stranger's appearance suggested a nativity of "way down East"—and so it afterward proved.

"I wonder kin er feller git er job araound here?" he finally asked.

"Sure," replied Bob, to whom the question was addressed. "Take this paper and pencil and tally each shovelful of coal as it is thrown into the furnace,—and don't get in the way."

For fully an hour the stranger was engaged in painstaking effort to mark accurately each count on the paper and many a jest at the ludicrous spectacle was passed between the busy stokers. At length, the chief engineer, making a final tour of inspection before leaving for home, observed the stranger and approached with the remark: "Visitors are not permitted here without a pass from the office."

"Thet's all right, I work here. An' jest at present I'm purty busy," was the reply.

The chief for a moment was plainly puzzled. Then, as he noticed more closely what the stranger was doing, the light of understanding came suddenly. "I guess someone is playing a joke on you," he said. "Who hired you?"

"Thet feller over ther," replied the supposed victim. "An' I don't mind the joke s'long es I git paid fer it."

The chief roared with laughter, and the upshot of the matter was that the discomfited Bob had to dig down in his jeans and produce 50 cents, which the unruffled stranger pocketed with a drawled: "Thankee sir! Anything else I kin do?"

"What's your name?" asked the chief, when the merriment had subsided.

"Sam'l Eaton. Sam, fer short. An' daoun hum they twists th' handle an' calls me Eatin' Sam."

"Ever do any firing?" queried the chief.

Sam smiled sweetly. "Sure! That's haow I cum ter be here. Fired a 'tater-car all th' way daown frum H'ulton, Maine, an never had er tater freeze on th' trip, B'Gosh!"

This proved too much for the chief. "Come around in the morning and start in helping the boiler-washer," he said, shaking with laughter and starting for the engine-room.

As the weeks passed, Sam's presence in the boiler-room became more and more noticeable because of the careful manner in which he performed the many tasks alloted him, his quickness in noting defects and suggesting improvements, his easy-going, good-natured disposition and droll traits of conversation. If he had any bad habits they were carefully concealed. In fact, his averseness to spending his earnings foolishly, was frequently commented on by his fellow workers.

"What are you going to do with all the money you have saved?" he was asked by one of the stokers.

"Wa'll," he replied, "seein' es haow I hain't saved none, it's purty hard tellin' what I'll do with it. Yer see I didn't git much schoolin' daown hum, an' ther's er feller where I board what's got an eddication, but he's sickly an' cain't use it, so I'm givin' him 5 dollars er week fer what he calls 'tooterin' me. He needs th' money an' I need th' eddication, so I guess it's erbaout 'n even swap."

Results of the "tooterin" were not long in becoming manifest. The night fireman dozed a little too long, one night, and the hiss of escaping steam through a melted fusible-plug aroused him. The next morning, assisted by Sam, the chief started in to replace the damaged plug. The fire, of course, had been drawn, but the boiler was still hot and in such close quarters as the back-connection, the work was anything but a pleasure. Two or three pulls on the wrench, and the chief had succeeded in "rounding" the corners of the plug. Substituting a "Stillson" for the "Moncky" wrench he had been using, he tried again. This time the teeth of the wrench chewed off a considerable portion of the metal but the plug remained as firmly attached to the boiler-head as at first.

"Say, Chief," said Sam, who had been silently watching the abortive efforts, "ther's er feller up ter my haouse—"

"Do you think you can do this any better than I?" snapped the thoroughly exasperated chief.

"I'll try, if you'll git aout," returned Sam.

While the chief was at the sink washing the dirt from his bruised knuckles—a memento of the slipped wrench—Sam made a trip to the ice-water tank and re-entered the back-connection. A few minutes later, in response to the chief's—"How are you making out?"—Sam handed him the old plug and asked for the new one.

"How did you do it?" asked the astonished chief when Sam, the job completed, had squirmed through the small doorway and was brushing the dirt from his overalls.

"Ther's er feller up ter my haouse thet's tooterin' me, an' I jest happened ter reckerlect thet he told me thet heat expands anything and cold contracts it, so I tried holdin' er piece of ice on th' hot plug until it got cold an' th' dern thing turned aout es slick es er whistle."

Sam got the careless fireman's job. And a few months later, when a new engine was being installed and the erecting engineer needed an assistant, Sam was selected. When the work of erecting was finished, it was Sam who was intrusted with "breaking her in." And when I left to accept another position, Sam procured a license and was given a regular "trick" in the engine room.

For 9 years I was employed in a distant city and on my return, last month, I called at the old plant to shake hands and renew acquaintance with those of my former fellow workmen who were still in the employ of the concern.

I was so interested in discussing the many changes which had been made, that it was some little time before I thought to inquire about the health of my former chief.

"Oh, he's left us," was the reply.

"And where's Sam?" I asked. "Sam Eaton, the 'down Easter,' that the boys used to have so much fun with."

My friend laughed and looked at me queerly. "Follow me," he said.

He led me to the section of the building set apart for offices for the heads of departments, and pointed to one of the doors.

My mouth opened involuntarily from surprise, for there, in gilt letters, modest in size but brightly shining on the glass of the door, I read:

"SAMUEL EATON"
"CHIEF ENGINEER"

FOREIGN DEVELOPMENT IN THE POWER PLANT FIELD

Recently Developed Process for Autogenous Welding

By J. H. Blakey

In La Nature, M. Chalmares describes the soldering of heavy castings. Soldering of cast iron is always difficult, and especially so with large pieces; in fact it was considered impossible until a short time ago. Now, by means of autogenous welding and suitable fluxes, tools weighing as much as 6 tons have been successfully repaired, and have given as good service after breakage as before. The operation, however, cannot be properly performed without proper appliances and expert knowledge.

Autogenous welding can be done by means of the electric arc by aluminothermy, or by the oxy-acetylene torch. In welding by aluminothermy, the heat is produced by the chemical combination of oxygen and aluminum. It has been known for some time that high temperatures could be obtained by the formation of alumina (oxide of aluminum), but the operation was not practically applied previous to the invention of the process patented by Dr. Hans Goldschmidt. This consists in mixing finely powdered aluminum (the so-called aluminum bronze powder) with some pulverized metallic oxide, usually iron or chromium, although sodium dioxide is particularly effective. The mixture, which is called themit, is then raised to the temperature at which occurs the reaction by which the aluminum deprives the other metal of its oxygen, forming Al_2O_3. This reaction generates a great quantity of heat and a very high temperature.

In addition to welding, the process is used for the production of pure metals which it has not been possible before to isolate completely and in pure form, such as chromium, manganese, etc.

In welding, the thermit is placed in a specially prepared crucible and the reaction is started by ignition. The fluid mass of iron produced is poured into a mold around the joint to be welded. This method is especially useful for repairing parts of machinery which must be mended where they are used.

When aluminum is used for the separation of metals an important byproduct is formed; namely the melted aluminum oxide or alumina. This is an artificial corundum, and it has been called corubin. Its uniform hardness makes it far superior to natural corundum or emery for grinding and polishing.

A great obstacle in the aluminothermy process has been the lack of some means of starting the reaction, which requires a high temperature. Dr. Goldschmidt accomplishes this by using an igniter consisting of a readily reducible oxide, such as barium peroxide, mixed with finely powdered aluminum. The reaction of this mixture may be started by means of a match. A pinch of this placed upon the thermit or other aluminothermic mixture, will serve to start the reaction. Once started the main reaction propagates itself, since the temperature produced is probably above 5400 deg. F., which is higher than can be obtained by any other artificial means, except by the electric arc.

In 1895 Prof. Le Chatelier, in a note to the French Academy of Sciences, fixed at 7200 deg. F. the temperature of combustion of a mixture of equal volumes of oxygen and acetylene; the products of the reaction being entirely formed of oxides of carbon and hydrogen, reducing gases which play an important part in autogenous welding. For it is not sufficient to liquefy the metal; it is necessary, also, to preserve at the point treated the same composition, homogeneity and mechanical and physical properties as in the adjoining parts. This explains the difficulty of the process and the necessity for special equipment. The casting is first carefully examined, in order to determine the method of treatment and the flux which is most suitable; some of the fluxes must be prepared at the time they are to be used, as they preserve their properties for only a few hours.

After this examination the casting is taken to the machine shop, where is done whatever machining may be necessary to prevent any displacement during the operation. Small pieces are placed in a furnace equipped with suitable appliances for handling, and with means for steadily increasing and decreasing the heat. In the case of a large piece, a furnace is built around it, the same precautions being taken for the

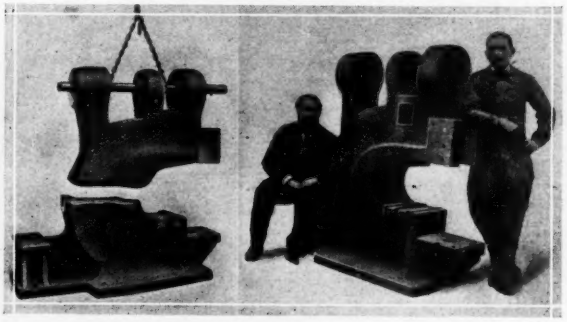


FIG. 1. BROKEN CASTING REPAIRED BY AUTOGENOUS WELDING

regular increase and decrease of the heat. When the assembled parts have reached the required temperature, the electric arc or the oxy-acetylene torch is applied at the point to be soldered. After cooling, the piece is again taken to the machine shop, where the seams resulting from the welding are removed, and any machining done which may be necessary for the remounting of cutting or finished parts.

In addition to soldering, a similar process is used to coat nickel steel cylinders with an interior lining of cast iron. This lining is half a millimeter in thickness, and by means of a special flux called "Fontine" it is welded into the steel so as to form a solid piece. This gives a cylinder of great strength, and also satisfactory as regards the friction of the piston. Similarly, steel cylinders can be coated on the outside with cast iron, and then cut into segments to make piston rings.

An Improvement on the Diesel Motor

THE house of Sulzer, of Winterthur, Switzerland, which has made a specialty of the manufacture of Diesel motors, and generally of 2-cycle motors of great power, has added to the Diesel motor an arrangement for cleansing the cylinder by means of a volume of air after each explosion. Figures 2 and 3 show the apparatus. At A is the port for the escape of the burnt gases. At S and H are ports connecting the air reservoir N with the cylinder. It will be seen that the upper port, H, is in communication with the cylinder only when the valve, G, is raised, and that the upper edge, a, of the port, H, is a little higher than the upper edge, b, of the escape port, A. The lower edge, c, however, is below the edge, c, of the port, A.

When the piston descends, as the result of the

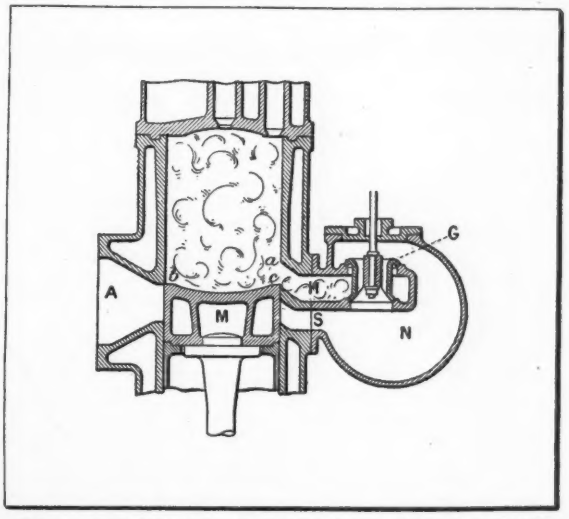


FIG. 2. POSITION OF AIR VALVE JUST BEFORE EXHAUST

explosion of the gases, it passes first the port, H, which does not allow air to pass into the cylinder on account of the valve being closed. It then passes the port, A, which allows the escape of the burnt gases; the pressure in the cylinder becoming gradually that of the atmosphere. The piston, continuing to descend, opens the port, S, which allows air from the receiver, N, slightly above atmospheric pressure, to enter the cyl-

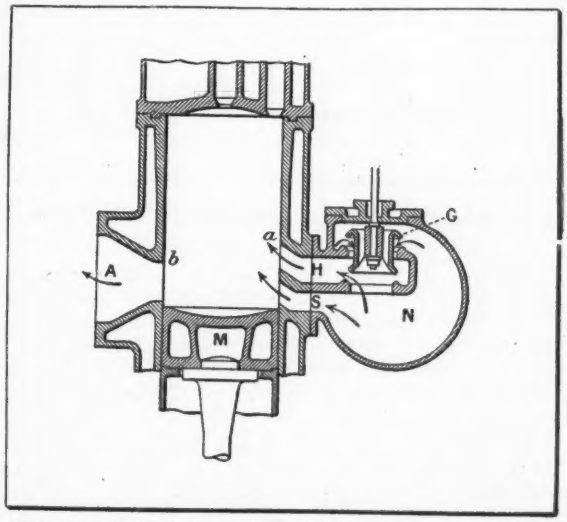


FIG. 3. DIRECTION OF AIR CURRENTS WHEN PISTON IS AT END OF STROKE

inder. As the piston starts its ascent, an eccentric suitably arranged, opens the valve, G, and the port, H, which having, as has been said, its upper edge above that of the port, A, allows the inflow of air for a moment after the port, A, is closed. This device has been found to increase the efficiency of the motor, no doubt because the remnant of burnt gas remaining in the cylinder is replaced by a volume of clean air.

LETTERS DIRECT FROM THE PLANT

Cash Paid For Ideas Accepted. Sketches Desirable.
We Make The Drawings

REMOVAL OF HARD SCALE FROM ECONOMIZER TUBES

ONE day, a fireman noticing some hot water and vapor coming out of the soot-chamber under the economizer, reported the matter to me. On going to the spot, and seeing that what was reported was true, all its connections with the boilers and feed pumps were cut off, and water was allowed to go into the boilers directly from the pump. The gases from the boilers were also directed to the chimney through the reserved flue. (See Fig. 1.) When the economizer flue was cooled down, a man went in through the soot chamber for inspection and found that one of the pipes in the last section of one set had burst. As we had one pipe in spare, we

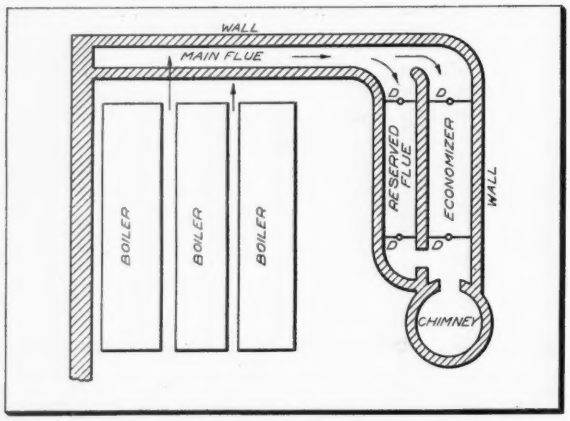


FIG. 1. ARRANGEMENT OF BOILERS AND ECONOMIZER

thought of replacing the broken one. To do this, we disconnected the top and bottom branch pipes, then it was found that some of the pipes had choked up fully and some of them were nearly so, with hard scale. Therefore, it was necessary before putting the economizer in working order, that all the scale from the pipes be removed.

Undoubtedly the scale could not be removed by any other means than boring out. Therefore, we made a simple boring bar as shown in Fig. 2, to bore the pipes in their place, and began the work by employing 2 men to turn the handle of the boring bar, but it took so much time and labor to clean one pipe, that the plan was given up as useless, and some other mechanical contrivance was thought of.

This mechanical contrivance shown in Fig. 3 was made out of some old materials at hand. We had one old lathe bed 14 ft. long, which we fixed in the ground near a line shafting which was passing through the yard to drive another department of the mills.

The tail stock was fitted as usual but with a hollow center, as shown at H, Fig. 3, instead of the pointed one; and in place of head stock 2 wooden blocks were fitted to support the boring bar.

The boring bar was made as separately shown in Fig. 4, in which a hydraulic pipe, H P, 3½ ft. long, was turned the whole length on outside and was bored out inside, up to the distance of 3½ in. from both the ends to fit the iron bushes, shown in Fig. 4, which were driven into the pipe to keep the rod R, in the center. On the outside of the pipe one loose and one fast pulley, 16 in. in diameter, were fixed to drive the whole arrangement. The loose pulley was fixed on the separate collar and the fast one was fitted with a sliding key fixed in the slot 2 ft. long, which was cut in the pipe, shown at A in Fig. 4.

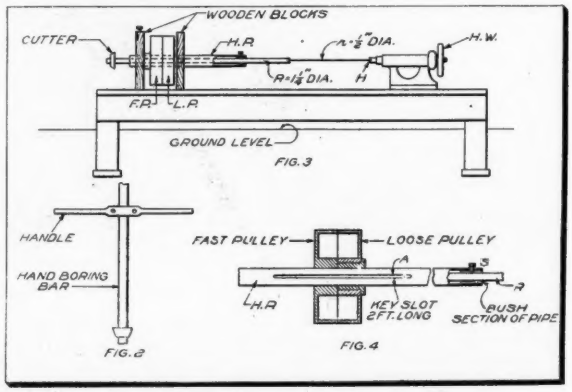


FIG. 2. HAND BORING TOOL FIRST USED
FIG. 3. LATHE ARRANGEMENT FOR BORING SCALE FROM TUBES
FIG. 4. DETAIL OF DRIVING SCHEME ON TUBE BORER

The rod R was kept tight with the bush by a set screw S; and some different lengths of ½-in. rod, R, pointed at both the ends, were kept ready to push the boring bar by the hand wheel of the tail stock.

Now, to bore the pipes, one section was brought near the apparatus which was only about 50 ft. distant from the wall. The center of the pipe was made level with the center of the boring bar with the help of wooden blocks, having grooves cut in them, according to the size of pipes and spaces between them, and the whole section was made tight to the blocks with bolts and flat irons.

When all things were ready, the belt was moved from the loose to the fast pulley, and the boring bar began to cut the scale smoothly. The bar was being pushed by the handwheel of the tail stock, which in turn pushed the rod, R, together with the pipe, H P, through the wooden blocks.

When the pipe would come to the extreme end of its travel, the set screw, S, would be slackened and the pipe would be drawn back towards the right-

hand side, and after tightening the screw, working would be resumed again. Whenever the distance between the tail stock and the end of the rod R would increase, a longer ½-in. rod would be placed between them instead of the shorter rod.

This contrivance did good work in cutting the scale, but one more difficulty was experienced, that was removing the loose scale (dust) from the pipe. First, we tried to remove this by the bent flat irons, but it took a good deal of time, and sometimes the cutter would be jammed so much that it would not go any farther and the machine would stop. When this happened it took much more time to remove the scale than was required for boring. Thus, we were able to bore 2 pipes at the most on the first day.

When once the cutter was jammed as before, we threw a bucketful of water into the pipe, as a trial, but this had such a good effect that the scale was loosened and came out in the form of mud. Therefore, we made a water connection with the fire-service hydrant and put the nozzle of the hose into the mouth of the economizer pipe while working By this the work was made so easy that we were able to bore and clean about 20 to 30 pipes a day.

The contrivance was made from the old materials which were found at hand. N. N. Bava-Adam.

BOUNCING DASHPOTS

OUR dashpots are of the vacuum type and consist of a pot and plain plunger without any kind of packing. They would stick up and let go too soon when our cylinder oil was poor or when the engine was not getting enough or when the working edge of the steels were worn or when the receiver pressure would suddenly go down, as is the case when a heavy load is thrown on; but as for bouncing, we had never heard of it till our working hours were changed from 12 to 8 and another engineer was hired. The first day, one of us stayed with him to show him the ropes, but the second day, the dashpots started to bounce on both high and low pressure.

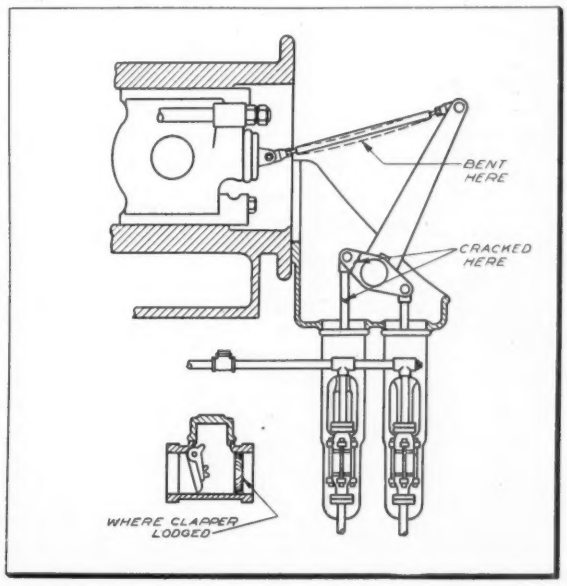
Our engine is a double eccentric, belt-connected to a shaft. She did not speed up and the only danger I could see was the liability of the closing shoulder banging on the jim-crank web until it marked it and might break it, but the disagreeable noise was hard to stand. We tried everything we knew, but it seemed to do no good.

After reading Mr. Waldron's article in the Oct. 15 issue, I saw a light, so I hung around to watch the new engineer when he oiled the valve gear. We had always thought that the dashpots had sufficient oil from what ran down the rod. Not so, the new man, however, for every time he oiled the valve gear he gave a liberal dose on the dashpots. At noon we shut down and removed the dasher out of the pot, and there was about ¼ in. of oil in the bottom, which decreased the clearance between the dasher and pot, so the air trapped was at a higher pressure when the dasher had dropped. Also, the oil moved so slowly that it partly filled the air passages, thereby reducing the movement of the air and causing the dasher to pound. We poured kerosene in all the dashpots and told the new engineer to stop putting oil on the dashpots and our troubles were over.

At the plant where I work there are 6 engineers, a chief and 8 firemen, also 3 machinists. We have a club for educational purposes and we discuss the merits of articles appearing in Practical Engineer and other technical papers. Charles Miller's article on the Brown engine valve came in for a lot of praise, as none of us had ever heard of the screw to prevent the exhaust valve from chattering, but Brown engines are scarce in this locality. I happened to say that Mr. Miller's sketch was not just right and of course I was asked to point out where it was wrong; I would rather leave it to some of Practical Engineer's readers to decide. J. E. Kemsley.

CHECK VALVE TROUBLE

ACCOMPANYING is a sketch of an accident that happened in the plant where I am employed as engineer. One of our pumping engines is a cross-compound, 30 by 52-in. cylinders, and built like a triple expansion engine; that is, it has 3 cranks but no cylinder on the intermediate, as the crosshead from it drives the pump shown in the sketch. This pump is used to handle the condensed water from our heaters and discharges into a tank against a head of 30 ft., so there is no pressure on the line. About 2 ft. from the pump, on the discharge line, is a horizontal swing check valve and there are no other valves of any kind in the line.



BROKEN PUMP PARTS DUE TO CHECK VALVE DIFFICULTY

About 11:30 a.m. one of the gaskets blew out and we shut off the suction and repaired it at once, as we did not need to shut down to do so. When the bolts were all tightened up, I opened the gate on the suction line and before I could move, one of the other gaskets blew out and scalded my leg and the arm from the shoulder down. It was then decided to put in sheet lead gaskets all around. After this was done, the suction was opened and everything went fine until about 3 hr. after, when a loud report was heard, and on investigating, we found the rocker arm broken, the connecting arm cracked, and the reach rod badly bent.

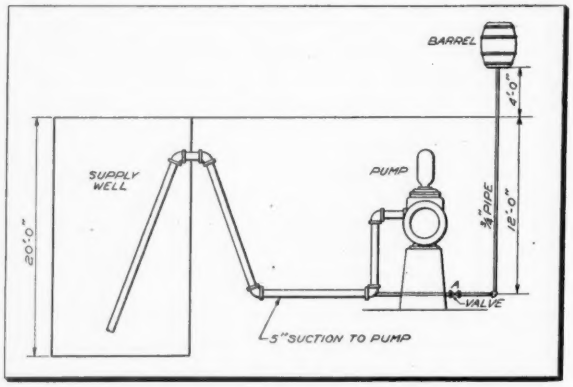
On taking the pump apart, we found that the clapper in the check valve had become loose and worked up to the 2-in. nipple, as shown in the small sketch, and shut the flow off the same as a gate; the more pressure was placed against it, the tighter it held. This was taken out and another straight left check put on, and we have had no further trouble.

C. R. Van Keuren.

COMPOUND FEEDER

THE accompanying sketch shows a device we installed to feed compound into our boilers, until we could obtain the regular feeders. We mixed the compound with water in the barrel, and by opening valve A, fed it direct into the pump suction. The barrel being 4 ft. above the supply well, we had to fill it with a bucket.

One day, several hours after emptying the barrel, we noticed it was full and running over; as none of us had put any water into it, we investigated and found valve A slightly open.



ARRANGEMENT FOR FEEDING COMPOUND

We emptied the barrel and tried it again, finding that we could fill it in about 2 hr., by cracking the valve just the right amount.

The only reason I could give for this is, that the velocity of the water coming to the pump was high enough to overcome the head from the barrel.

This has been declared absurd by several, so I should like to hear some other explanation.

R. M. Packingham.

COVERING STEAM PIPE

THERE are few power plants that do not have at least part of the steam pipes insulated with some kind of pipe covering, and, in many plants, it seems to me that the rule is to cover the pipe, and leave the flanges, valve flanges, and valve bonnets bare. Where there are few fittings this may be all right, but in some cases the valves and fittings are so numerous that if left uncovered there is much surface exposed to radiate heat.

In a certain modern office building plant much pains were taken to cover the pipe, but the flanges and valve bonnets were left bare. In the main steam line and branches to the engines and boilers there are 900 sq. ft. of surface covered, and 420 sq. ft. of surface in the valves, flanges, etc., left uncovered, not including the bolt heads and nuts, all of which radiate heat to the engine room, or, in other words, about 46½ per cent of the surface in the steam system is left exposed. It has been experimentally determined that each square foot of bare iron pipe surface will radiate about 3 B.t.u. per hour for each degree difference in temperature between the steam and the surrounding air, the exact amount varying with the existing conditions. For practical purposes 3 B.t.u. per hour may be assumed. The loss from condensation in bare pipe may be figured from the formula:

$$\frac{3A\,(T-t)\,NC}{970 \times 2240E} = \text{Cost per annum of steam condensed in bare pipe, in which}$$

A = Area of exposed pipe in sq. ft.

T = Temperature of steam in degrees Fahrenheit.

t = Temperature of air surrounding the pipe.

N = Number of hours per annum that steam is in the pipe.

E = Equivalent evaporation from and at 212 deg. per lb. of coal.

C = Cost of coal per ton, including handling, ash removal, etc.

In this plant the steam pressure is 100 lb. (337 deg.), the temperature of the engine room averages 100 deg. steam is on the line the year around or 8760 hr. per year, and the boiler evaporates about 10 lb. per lb. of coal which costs $3.75, including coal and ash handling per long ton.

Applying this rule to the case in hand, it shows that if the pipe that is covered were left bare the cost of condensation per annum would be:

$$\frac{3 \times 900 \times (337-100) \times 8760 \times 3.75}{970 \times 2240 \times 10} = \$984.71$$

per year which is saved by covering the pipe.

There are also 420 sq. ft. of surface in the valves, flanges, etc., that are not covered, and the loss from this source is:

$$\frac{3 \times 420 \times (337-100) \times 8760 \times 3.75}{970 \times 2240 \times 10} = \$452.31$$

per annum that would be saved by covering these parts, making a total saving of $1437.02 per year in coal by covering the entire system. Flanges are usually left uncovered because it is relatively more expensive to cover them than the pipe, also because of the necessity of frequent repairs to the joints; but removable flange covering may be had which makes it possible to protect the flanges, and yet be able to remove, and re-apply the covering, or a non-removable covering may be had at a lower first cost.

In covering small steam pipe, the fittings and valves are covered without any thought of leakage, and if used the same way on large sized flange pipe there will be less trouble from leakage, which is often caused by expansion and contraction of the pipe, due possibly to cold air striking it. In the case cited much trouble has been had from leakage in the threads, although only 1 or 2 of the 128 gaskets have ever leaked. The point where the leakage occurs is bare and exposed to the air, and I think this is the main cause of the leakage, as there is no vibration in the line.

J. C. Hawkins.

A HIBERNIAN STOKER

O'BRIEN had been a boiler fireman but a short time; during his temporary absence from the front of the boilers one of the other firemen threw a good sized chunk of boiler plate into O'Brien's furnace right on top of the fire.

A few minutes later the gong sounded, coal up fires, and when O'Brien opened the furnace door, he dropped his shovel, and ran yelling, with all his might, for the watertender, "Joe! Joe! Come here quick—the side av a biler fell out."

J. A. Snyder.

REFITTING A CRANKPIN

SOME time through the night, the crankpin on one of the engines got loose, and the night engineer routed me out of bed and told me to make and fit a new pin, and furthermore, to have it finished by morning, as the engine must be ready to run at that time.

After looking the job over, I saw that I would not have time to make a new pin by morning, but the idea struck me that the old pin could be used over as it was a taper fit and had a solid collar on it, as shown in Fig. 1.

I put it in the lathe and turned the collar down to 6 in., the same size as the working part of the pin, and then faced back the shoulder at A, ⅝ in., which was ⅛ in. less than the width of the collar. I then got the size of the hole in the disk, made the fit on the pin and faced the end of the pin at B, back

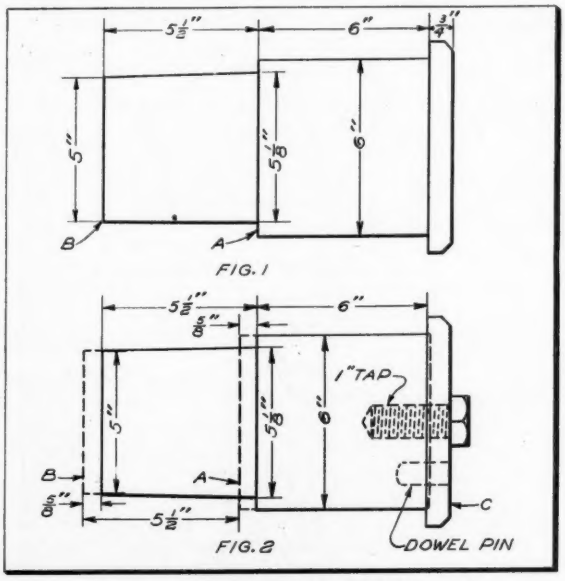


FIG. 1. DIMENSIONS OF ORIGINAL PIN
FIG. 2. DIAGRAM OF NEW PIN

⅝ in., which made the fit the same length as before, and the working part ⅛ in. longer. I made a loose collar to fit over the end of the pin by countersinking it back ⅛ in. A 1-in. tapered hole was put in the end of the pin and a 1-in. drilled hole in the loose collar, and a 1-in. cap screw held them in place, then a dowel pin was put in to keep the collar from turning.

The pin complete is shown in Fig. 2. The dotted lines at A and B show where the pin was faced back.

We now had a pin as good as new, the only difference being in the collar, as it was now fastened on with a cap screw, when before it was solid.

The pin was then pressed in the disk and the engine started, and it has been doing all right to date.

E. Stevens.

A PECULIAR CONDENSER TROUBLE

THE cooling water for our ammonia condensers, after passing through them, was used on 2 Wheeler steam surface condensers. This arrangement had worked very well for several years. The water used was taken from the city main.

To cut down expenses, the company decided to bore a well to supply water for this purpose. This was done and proved a success from the start. A new pump was installed at the same time for the circulating water and, being in a rush for it, we neglected to put a gage on the discharge line. Everything went well for a few weeks, when we noticed the pump began to require more opening of the throttle valve to run it and it gradually kept getting worse, until finally we had to open the throttle wide in order to get enough water for the condensers.

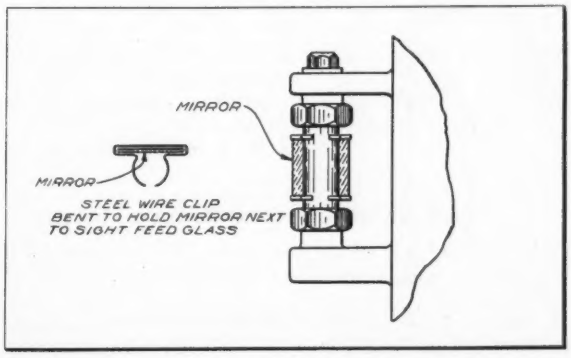
I had a gage installed and found we had about 150-lb. pressure on the line. At the same time the steam condensers were running a good deal hotter than they usually did; also, the condensation pumped away from them was considerably less. I next tried a gage in the line from the ammonia condensers to the steam condensers and found there was only a drop of about 20 lb. through the ammonia condensers.

After examining all the valves we took the heads off the steam condensers and the cause of the trouble was evident. The condenser tubes were nearly all closed by a brick-like scale and just as hard. We had to use a small drill at the end of a long rod to remove the scale and it took several days of hard work to do it. After we had the condensers cleaned we used city water on the steam condensers and had no further trouble.

Thos. G. Thurston.

MAKING LUBRICATOR FEED VISIBLE

FEED of a lubricator is something which must be closely watched, both from the standpoint of oil economy and justice to the machine to which it is attached. The lubricator is only too often placed in locations making it hard to see plainly the feed of the



MIRROR ATTACHED TO LUBRICATOR TO MAKE THE OIL MORE EASILY SEEN

lubricator as the drops pass up through the sight-feed glass. The sketch shows how a small piece of mirror can be held near the sight-feed glass and which will make the drops clearly visible under extreme conditions of poor illumination with which the lubricator may be surrounded. The writer placed the above arrangement on a number of lubricators operating on pumps in a dark boiler room, with the satisfaction of making the passage of oil through the feed glass clearly visible a considerable distance from the lubricator necessarily placed some distance up on a steam pipe.

F. W. Bentley, Jr.

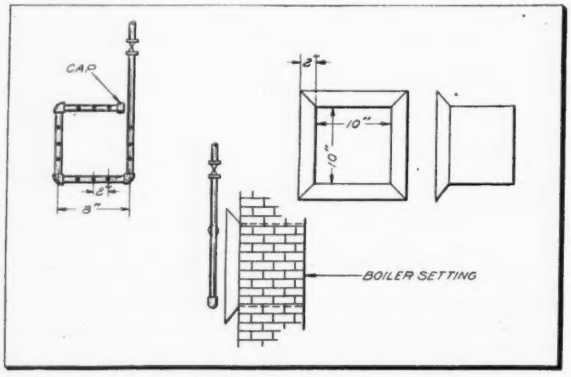
AT SPRINGFIELD, MASS., the United Electric Light Co. soon will have erected a large service station for use in the distribution of current about the city and the vicinity. The proposed building will be about 200 by 80 ft., and 4 stories high.

Successful Kinks From The Plant

For Saving Time, Work and Trouble

Forced Draft

IN a plant where I used to work we had an 80-hp. return-tubular boiler that is hard put for steam, so we made a blower out of ½-in. pipe. We drilled 3 ¼-in. holes in each piece of pipe. Next we cut a



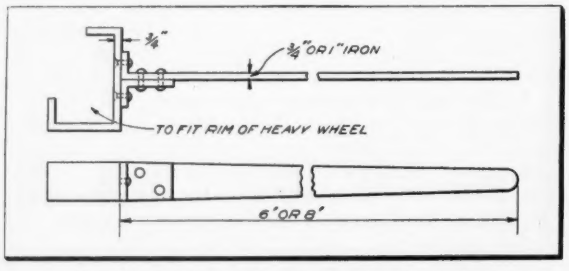
HOME-MADE BLOWER FOR BOILER FURNACE

hole in the setting about 10 in. square, got some pieces of sheet iron, cut them and placed them in the brick work. This blower is connected to an overhead steam pipe. The illustration shows the arrangement.

T. J. Sullivan.

Jig for Off-Centering Engines

HEAVY flywheels of a great many engines are sometimes the cause of no little trouble when the engine must be moved off of the dead center, in which position any engine not uncommonly stops. Of course with a great many engines, special provision is made for such an occurrence, but in not a few engine rooms the writer has seen the engineer greatly concerned when the engine slows down on a stop.



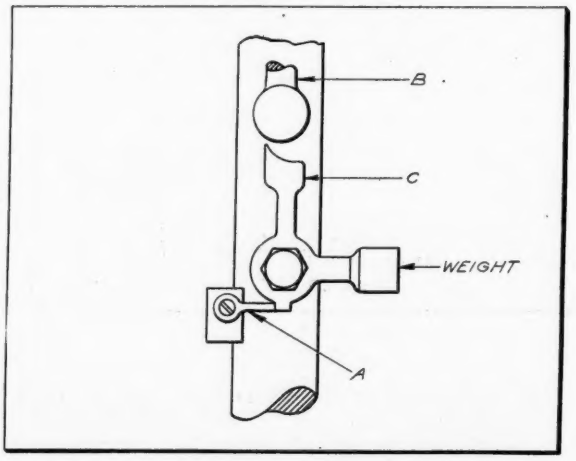
HOME-MADE DEVICE FOR OFF-CENTERING ENGINE

The accompanying sketch is descriptive of a jig with which it is possible to move singlehanded a very heavy flywheel. It is instantly applied to and removed from the heavy rim of the wheel, and with a handle to suit the weight of the wheel affords an easy means of off-centering the engine. Of course its construction must vary to suit that of the wheel rim. The device was used in an engine room having a number of Ball engines connected direct to generator, and it was certainly worth the time required to make it, as one of the engines frequently stopped on center.

F. W. Bentley, Jr.

Governor Stop

THIS little device was designed to replace the governor stop pin which is common to so many of the older types of Corliss engines and does not depend upon the engineer's thoughtfulness to render it operative in case of accident as does the stop pin. It is so simple it needs but little explanation. Just before



DEVICE USED IN PLACE OF A GOVERNOR STOP PIN

shutting down, the latch, A, is placed against the lug on stop, and when the governor rod, B, drops, owing to decrease in speed, it pulls over C (which is out of line of B) and causes latch A, to fall.

In starting, when B rises, the weight pulls C out of the way, so that governor may drop if belt breaks.

THE ABERTHAW CONSTRUCTION CO., recommends the following method of curing a dusty concrete floor: Get the surface entirely dry, then paint with a mixture of boiled linseed oil thinned with gasoline. Give it several coats, until the oil shows glossy on the top. A little experimenting will show the proper proportions. The thinner the mixture the more coats will be required and the deeper it will strike in.

THE NORTHERN VIRGINIA POWER CO. turned its current into the plant at Berkeley Springs. The Virginia company bought this plant from the old Cacapon Power Co. and made changes so as to carry a current from its water plant.

Questions Answered and For Answer

Expert Help When In Trouble. If You Want Quick Answer Enclose a Stamp

Practical Questions on Operating Ice Plant

I WANT to clean the ammonia coils in the freezing tank, by blowing steam through them. Not having an air compressor, how can I remove the condensation after the steam blowing?

2. How can I detect air in a compression ammonia system? How can I remove the air when once discovered?

3. How can I level the bottom of a freezing tank, which has so much sag in it that some of the cans float and consequently the ice cakes are crooked?

4. In soldering leaky ice cans, how can I remove foreign matter from leaky joints? What flux is best for this work?

5. What are the objections or disadvantages to an open boiler feed-water heater?

6. What is the best plan for cleaning a copper coil of a boiler feed-water heater that is filled up with lime, sulphur, clay, etc? W. H. P.

A. By pumping all the ammonia out of compressor and opening suction side of machine below main suction valve on suction pipe, disconnecting discharge from high-pressure discharge pipe below main discharge valve, and turning machine into air compressor to blow out coils, do not run compressor very fast unless you have a water-jacketed cylinder.

2. If it is a double-acting machine it will fluctuate in temperature on discharge pipe—that is, run hot and cold.

If it is a single-acting machine it will show an excess of pressure on high-pressure side. Remove the air by pumping all the ammonia into the condenser. Allow the water to run over condenser coils for some time until all the ammonia is condensed, then blow air out from the highest point of condenser through a small pipe into a bucket of water. Most condensers have an air pipe connected to the highest pipe on condenser; or you can put an air chamber with suitable valve connections to shut it off when air is trapped in, then condense ammonia down and blow out air.

3. If foundation of freezing tank has done settling, and tank has sufficient supports, it can be leveled with thin course of asphaltum in low spots, the asphaltum to be mixed with plenty of flax and not made too brittle. Let it set well before cooling down and be sure not to cool it down too suddenly.

4. Better get a good tinsmith for this work.

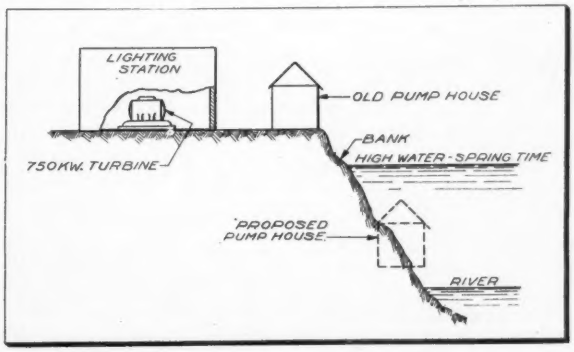
5. Objections of open heater without good oil separators are, they will let some oil out of exhaust steam get into boiler and that is apt to damage boiler, also it has to be placed above boiler pump suction to get feed water to pump.

6. If copper coils are entirely stopped up, better take them right out to clean them. If not stopped up, you can pump them full of sal soda water and let stand for 24 hr., then wash out and try soda again until clean. J. H. B.

Proper Location for Pump House

THERE has been some little trouble at times with our lighting plant here, claimed to be due to low water in the river and the location of the pump house. The pump house is now located so that the pump lifts the water along 110 ft. of the pipe to deliver it to the turbine; 3600 gal. per min. are required. The new superintendent has pointed out that this was faulty construction, and did not allow the pump to do as effective work as if it were placed at the river bank. The city has had only 2 shutdowns of a very short period during the time the turbines have been in operation, which is about one year.

The river at this point is about 200 ft. wide at tide-water. The point I can't see is, what has the location of the pump house to do with low water? In the spring the water in this river is very high, sometimes for a number of weeks. If they discard the old pump house and locate one as shown in the sketch, it looks to me as though we are going to have trouble every spring, a more serious proposition than low water. I claim that the engineer who installed the old pump house used good judgment, if not as effective. As the water is now taken from a well at the river bed, why not increase the size of this well and save some of this expense? I should be pleased if you would give me your opinion in this matter. W. H. P.



PRESENT AND PROPOSED LOCATION OF PUMP HOUSE

A. After looking over the situation in regard to your pump house, we do not see how it can be advisable to put the house below the line of spring high water. Of course, a lift through 110 ft. of pipe is not to be desired, as it slows up the action of the pump and is likely to result in a good deal of slip through the suction valves. But a drowned pump house in spring would certainly be an impossibility.

We do not quite see the point that you make of increasing the size of the well at the river bed, unless this well is so small that the pump draws down the water level in it to a considerable extent.

Is the arrangement such that there is a deep well pump operated from the pump house, or is the well located at a distance along the river bank? Of course, 110-ft. lift by suction is impossible, and we do not understand quite how this is arranged. A. L. R.

Mechanical Questions

HOW do you find the pitch of rivets in a butt-strap joint?

2. Please explain how to take measurements for a new connecting rod.

3. How are the number of expansions in an engine cylinder calculated?

4. How do you increase the speed of a Putnam engine with old style governor?

5. How can the speed of a Corliss engine be increased? G. W. B.

A. There are several designs of butt-strap joints as applied to boiler construction and the method of finding the pitch of the rivets in each differs considerably from the others. Then each of several states and municipalities has a method which differs in some respects from the others, so it is not possible, with a given type of butt-strap joint, and a given thickness of plates, to give a formula that would be acceptable in these several communities in every particular.

However, most authorities are agreed upon the following formulas which meet with general approval:

In each case we will assume that the thickness of the plate is ⅜ in., or .375 in., which requires a ¾-in. rivet and a 13/16-in. hole. For a double riveted butt joint with 2 cover plates:

Pitch for the inner rows equals the thickness of the plate times 1.5 plus 1.8125. Reducing this to figures we have (.375 by 1.5) + 1.8125 = 2.375 in.

The pitch for the outer row of rivets is just twice that of the inner row and the distance between the rows is equal to the thickness times 2.9 plus 1.35. Reducing this to figures we have (.375 by 2.9) + 1.35 = 2.437 in.

For a triple riveted butt joint with double covers: Pitch for the inner rows is equal to the thickness of the plate times 4.44 plus 1.39. Reducing this to figures we have (.375 by 4.44) + 1.39 = 3.05 in. The pitch for the outer row is twice that of the inner rows and the distance between the rows is equal to the thickness times 4 plus ⅛ in. Reducing this to figures we have (.375 by 4) + .125 = 1.625.

2. Move the crosshead to the extreme of travel so that it will strike the heads and while in each of these 2 positions, from a given point on the crosshead make a witness mark on the slide or guide, in any convenient manner.

Now place the crosshead half way between the two witness marks, measuring from the point on the crosshead itself to the ones on the guide. This places the crosshead in the exact mid stroke. If the shaft is in the proper position, the length of the connecting rod will then be the distance between the center of the crosshead pin and the center of the shaft.

The stroke of the engine is just twice the radius of the circle described by the crankpin in its travels. Therefore, if the crosshead is at mid stroke, in order to travel to either end, it will travel a distance equal to the radius of the crankpin circle, the center of which is the center of the shaft.

3. To find the number of expansions in the cylinder of an engine, divide 1, which represents the stroke of the engine, whatever it may be, by the point of cutoff, expressed decimally, and the quotient will be the number of expansions.

Suppose that cutoff takes place at 1/5 of the stroke, which expressed decimally is .20. Then 1 divided by .20 gives 5 as the number of expansions.

4 and 5. All types of flyball governors as used on engines are designed by the makers to revolve at a certain speed and while this speed can be changed within a small margin by adjusting the weights or springs which are attached for that purpose, yet no matter what speed it is necessary to run the engine the speed of the governor will remain the same and the speed of the engine is changed by changing the ratio of the pulleys or other device by which the governor is operated.

On the Putnam engine, the governor is driven from the lay shaft by means of bevel gears and if it is desired to make the engine run faster, it is necessary to put a larger gear wheel on the governor standard, and if the change be great, a new one on the lay shaft also, so as to bring the teeth in mesh properly. If it is desired to reduce the speed put on a smaller gear.

The speed of an engine, the governor of which is driven by a belt, is changed by changing the ratio of the pulleys. Increasing the diameter of the pulley on the governor makes the engine run faster; decreasing it, has the opposite effect. Instead of decreasing the size of the governor pulley to reduce the speed, the pulley on the main shaft can be increased by lagging or any other means and the same result secured. G. H. Wallace.

Safety Valve Problems

HOW would you proceed to set a lever safety valve?

A. First, ascertain by calculation, the required area of valve. Allow 1 sq. in. of valve area for each 2 sq. ft. of grate surface. Second, ascertain the number of pounds pressure exerted upon the stem of the valve by the lever itself, before placing the ball or weight upon it. This is done by leaving it in its position attached to the fulcrum, and connecting a spring scale to it at the point where it rests on the valve stem. Also find the weight of the valve and stem by means of this scale.

2. Give details of the setting.

A. Find the proper distance from the fulcrum at which to place the weight on the lever, when the pressure at which the valve is to blow off is known.

Rule. Multiply the area of the valve by the pressure, and from the product subtract the weight of the valve and lever. Multiply the remainder by the distance of the valve stem from the fulcrum, and divide this product by the weight of the ball. The quotient will be the required distance.

Find weight of ball, when its distance from the fulcrum is known; together with the pressure at which the valve is to blow.

Rule. Multiply the area of the valve by the pressure, and from the product subtract the weight of lever and valve. Multiply the remainder by the distance of the stem from the fulcrum, and divide by the distance of the ball from the fulcrum. The quotient will be the required weight.

To find the pressure at which the valve will blow, when the weight of the ball and its distance from the fulcrum are known:

Rule. Multiply the weight by its distance from the fulcrum. Multiply the weight of the valve and lever by the distance of the stem from the fulcrum, and add this to the former product. Divide the sum of the 2 products by the product of the area of the valve multiplied by the distance of its stem from the fulcrum. The result will be the pressure in pounds per square inch, required to lift the valve. (Note.) In the foregoing problems, the area of the valve must be expressed in square inches, and the weights of the different parts are to be given in pounds.

Correction of Pipe Radiation Data in the November 15 Issue, Page 1111

IT seems to me that the answer given to this question is wrong. The value of 0.64 B.t.u. per square foot per hour per degree difference of temperature for bare pipe radiation does not agree with the values given by George M. Brill, Transactions A.S.M.E., XVI, page 827, where the loss is given as 2.7 B.t.u. per square foot per hour per degree temperature difference.

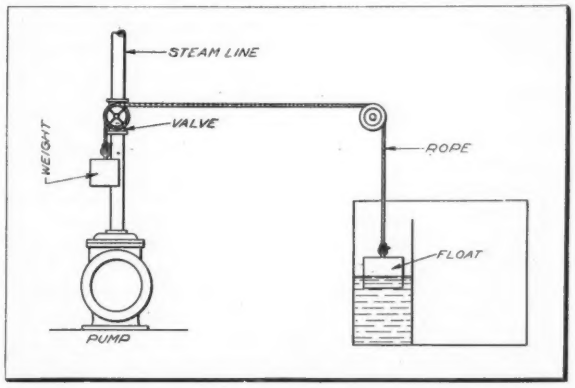
Taking this value, we have, $278 \times 0.66 \times 225 \times 2.7 = 111{,}464$ B.t.u. lost per hour. Dividing this by 2545, the heat units equivalent to a horsepower-hour, gives 43.8 hp. lost. The values as given in the Nov. 15 issue for steam saved by coverings of pipe are approximately correct, but the saving can be worked out more simply as follows:

From tests of pipe covering, the loss with magnesia is found to be 0.4 B.t.u. per square foot per hour. The loss for the pipe covered would then be, allowing for covering one inch thick, in proportion to the increased surface, and inversely in proportion to the loss per square foot. We should have as the surface per foot of length, $0.66 \div 2.5 \times 4.5$, or practically 1.19 sq. ft. per foot of length. To get the loss with covering, we then have, $111{,}464 \div 2.7 \times 0.4 \div 0.66 \times 1.19$, which gives practically 19,650. The saving would then be 91,814 B.t.u. per hour. If we allow that coal has 13,500 B.t.u. per pound, and that the efficiency of the boiler and furnace is 65 per cent, we should then have, $19{,}814 \div (13{,}500 \times 0.65) = 10.45$ lb. of coal saved per hour. W. E. Stearns.

Trouble with Oiling System

I AM running a 2000-hp. twin-tandem compound engine, and having a little trouble with the oil pump which pumps the oil from the filters into the tank about 30 ft. above the pump. While there is plenty of oil in the tank from which the pump is pumping and the pump runs smoothly, just as soon as the filter tank from which it is pumping gets empty, the pump naturally gets air-bound and consequently stops, and if the attendant does not happen to see it in time, the oil continually running, will overflow the tank and then run on the floor. Of course this is an unnecessary waste of oil; therefore, I suggested a float in the tank from which the pump is pumping and having it attached to the throttle valve and having it fixed so that the rise of the float will open the throttle and consequently start the pump, likewise the fall of float will close the throttle and stop the pump, but an ordinary globe valve will not do. I should like to know what kind of a valve would be suitable for the operation by the float. The size of pump, water end, is 3 by 4½ in., duplex, double acting, ½-in. steam line is operating the pump now, steam pressure 150 lb. gage. J. P.

A. The most common method of operating a valve from a float in the way that you mention, would be to attach a wire rope to the rod coming from the upper end of the float, or to an eye in the float, let this run up and over a pulley, be carried around a pulley on the valve stem and a weight attached at the other end. The counter weight and the float weight must be sufficient to put the required tension on the rope to operate the valve wheel. The size of the float and the amount of weight that it shall have over the counter weight can best be determined by experiment, and the



AUTOMATIC OIL PUMP GOVERNOR

size pulley on the valve stem will be determined by the amount of motion which you want the valve to have for a given rise of the float. Of course, a brass or iron pulley will be the most permanent arrangement, but a piece of oak board, turned up round, with a groove in the edge, will probably answer for the experiment work in finding out just what proportions you want to use. The direction in which the valve turns will be regulated by the way the rope goes around the pulley. A. L. R.

Shearing Strength

HOW is it that the shearing strength of a rivet in single shear is 42,000 lb. and in double shear it is only 78,000 lb.; why not be 84,000? M. E. C.

A. The reason that a rivet in single shear is allowed 42,000 lb. per square inch of cross section, and a rivet in double shear is allowed but 78,000 lb. and not double that of single shear, or 84,000 lb., is because these figures are the result of numerous exhaustive tests along this line to determine just what the limit should be with safety.

Some authorities even say that a rivet in double shear will stand twice what the same rivet will stand in single shear, but this is not followed in common practice.

It is the same way with the tensile strength of iron or steel, or any other metal for that matter; tests have been made by eminent experts for the very purpose of determining these facts and they have been found in practice to be for all purposes.

Boiler Patches

WILL some reader of Practical Engineer please explain the difference between a hard patch and a soft patch on a boiler? F. E. K.

Increasing Boiler Capacity

WE have 2 150-hp. boilers, 64 in. by 20 ft., containing 43 4½-in. tubes, grate area 20 sq. ft., stack 42 in. in diameter, 63 ft. above breeching, forced draft, and wish to know how to secure rating of boiler?

E. E. J.

A. The above dimensions indicate heating surface not more than 1065 ft., there being but 840 sq. ft. in the tubes and a total of 225 in the shell. This would mean then that to develop 150 hp. it would be necessary to get a rating of a horsepower per 7 sq. ft. With a basis of 12 sq. ft. per horsepower, the rating would come to about 90 hp.

While there are formulas for the size necessary to make a stack which serves well for cases where all conditions are normal, it is difficult to make application of them without analyzing the conditions. The formula devised by William Kent, which is widely used, is as follows:

Horsepower divided by 3⅓ equals the square root of the height times the difference between the area of the chimney in square feet and 0.6 of the square root of the area, the whole based on the assumption of its requiring 5 lb. of coal burned per hour per horsepower. It will seem upon reflection that it would be possible to get the same horsepower with a short chimney and large area as with a smaller area and greater height. As it is necessary to have a draft sufficient to overcome the friction due to grates, tubes, breeching and chimney, a sufficient height of stack is obviously necessary to get the required draft. To know what draft is required, it is necessary to be able to figure the various friction losses. The theoretical draft for a chimney 100 ft. high with average temperature of 500 deg. is at sea level 0.586 in. of water and any other height is proportional. A formula for determining the losses after the fuel bed is passed, based on theory and practice, is as follows:

$$P = \frac{K S V^2}{A}$$

P = pressure lost, inches water gage.
S = square feet, rubbing surface.
V = velocity, feet per minute.
K = constant = 0.000,000,053.

Applying this formula to this problem, we would first find the velocity of the gases. Assuming the average temperature through the tubes at 900 deg., there would be 1415 cu. ft. of gas per minute for every 100 lb. coal burned per hour. For 150 hp. at 5 lb. coal per hour per horsepower, we would have 750 lb. per hour or 10,612 cu. ft. of gas per minute. The internal cross area of the 43 tubes would sum up to 4.2 sq. ft.; 10,612 divided by 4.2 equals 2526 ft. velocity per minute. Considering the rubbing surface of one tube, we would have the internal circumference of 1.1 ft. times 20 ft. length or a total of 22 sq. ft. rubbing surface. The cross-sectional area of the tube is 14 sq. in. Substituting these values in the formula would give 0.53 in. friction in the tubes. Considering the bends and breeching as the equivalent of 30 ft. of stack, we would have in addition to the friction in the tubes the friction due to 100 ft. of stack, 42 in. in diameter. Assuming the average temperature in the stack to be about 450 deg. and applying the same formula as above, we would get a loss in friction of about 0.03 in. or a total loss of 0.55 in. A stack 100 ft. high with gases at about 450 deg. would give a draft about equal to this and if the friction through the fuel bed is overcome by forced draft, this stack would carry away the gases.

This would produce a condition which at times would build up a positive pressure in the fire box and cause annoyance in the burning out of the lining, door jambs and doors so that it would be desirable to have a stack somewhat in excess of 100 ft. A much better plan, where there is place to make it possible, is to have boilers of proper rating, sufficient grate area to burn coal with natural draft and at a rate which will enable the fireman to take careful pains with his fire.

With bituminous slack, a 30 per cent air opening, in grate, a square foot of grate surface, will burn about 15 lb. of coal with a draft loss of 0.3 in. or 25 lb. of coal with a draft loss of 0.4 in. Increasing the draft area in the grates to 40 per cent will bring the 15 lb. coal down to about 0.18 in. and 25 lb., to about 0.32 in. draft loss. If the plant is to run without forced draft, these amounts must be added to the friction due to tubes, breeching and stack.

P. M. Chamberlain.

TWO DIFFERENT ENCOUNTERS OF THE SALESMAN

Are You Either of These?

By A. M. Monia

THE salesman handling steam engineering supplies certainly has his share of adversities, with only an occasional dip into what one would call pleasure. I will endeavor to illustrate one of the many hard propositions he gets up against. I will also tell of a place at which it is a pleasure for him to call on account of the treatment he receives.

While the writer does not belong to any one of the orders entitled the "Knights of the Grip," nor the "Water Tube Cleaner Salesmen's Society," yet he has had a few lessons (and not from a correspondence school, either) in the art of trying to sell steam-plant accessories and supplies. I started out from one of the largest steam specialty houses in the Middle States, with everything looking bright, and a firm determination to make good, if such a thing were possible. As I was leaving the supply house the general sales manager stepped up to me and, handing me a piece of paper, remarked that it contained a list of names of plants and their engineers, that none of the other salesmen could sell any goods to, and as I had been so many years in the engine room, he looked to me to be able to get some business, etc. "We won't try to deal with the office staff nor that individual known as the purchasing agent. We will pass them all up and deal directly with the engineer."

The first place that I got into I met the engineer coming out of the engine-room door and was greeted in this manner: "If you're one of them ——— packing fellows you might as well mosey along, for there's nothing doing today."

"I am not a packing salesman," said I. "I am a steam-plant engineer and I want to see you about some little matters that will interest you, I think, if you can spare the time."

"Well, just step into the engine room and take a chair. I'll be back in a few minutes after I look at a producer outfit in No. 2 building."

I thought I had my man landed for something, but when he returned he opened the door of the engine room and, leaving it open after entering, spoke up

rather harshly to me, saying: "If you are representing any engineering beneficial associations, or are on a personal charity tour, or want to try to interest me or any of my men in any educational institutions or volumes, make your exit through where I entered," pointing to the door.

"Nothing of the kind I assure you, Mr. ———."

"Well, then, what is your errand?" said the engineer, drawing a chair up near me and sitting down in it.

"Well, now that you have the time and are interested, I will proceed. I am not soliciting for an information bureau; but, to get down to business, I want to know if there is any piece of machinery part thereof, any belt, any stuffing box gland or any electrical appliance in your plant that is giving you any trouble. Anything, no matter what, tell me of it and then I'll make a try to get that machine, or whatever it is, to working right."

"You are to the point," said the engineer, "and you are the first man that ever put such a question to me. I am having a great deal of trouble with the brickwork under one of the boilers here, and would like to get something that will hold up. What have you got to offer?"

"We can furnish you a steel mixture made up in any desirable shape in 10 days."

"All right," said the engineer, "here are the dimensions," giving me the size of the firebox, etc. "What is the price per cubic foot?"

This I gave him, f.o.b. place of shipment.

"Is there anything else that gives you trouble?" said I.

"Yes, I am having more than my share of trouble with the outboard end of that air compressor's air cylinder. I can't get a gasket stuff that will hold more than a few hours at a time," said the engineer.

"Let me see what kind of sheet packing you are using." He showed me a piece of which our house had sold many hundreds of pounds, but not for air nor ammonia; it is simply for medium water or steam pressures, say, up to about 80 lb. to the square inch. In taking up this sheet-packing matter with the engineer, you will note that I did not plunge right in and say: "Somebody has put some cheap, inferior article on to you," but I waited to see whose goods he was using first.

The outcome of it all was that he ordered 2 yd. of our 1/32-in. nonvulcanizing sheet packing of 36-in. width.

"Is there anything else?" said I.

"No, not today; but if you are about sometime next month, I may want some pump valves."

In a short time I was at another plant. I asked for the engineer and he told me to wait there in the engine room until he looked after something on the third floor. He returned in a few minutes and after I had told him what my business was, he said that he had just taken charge of the plant a few days before, and that he really did not know what was needed; but that if I would leave my address and a list of the supplies I handled, he would remember me. I thought I was elected to get my orders to vamoose when, to my surprise, the engineer began to get into a line of shop talk.

"In some of the plants that I have had charge of," said he, "I have had a lot of trouble with water glasses breaking, owing to their not having the right kind of washers to retain them in their places. What do you attribute this to, barring the alinement of the glass fixtures?"

"It is a common occurrence, too common. I dare say the whole trouble lies in there not being large enough washer to retain the glass in place, and in most cases the washer is made of an inferior grade of reclaimed material. For instance, a ¾-in. water glass on a boiler carrying 135 to 150 lb. pressure to the square inch, should have a washer that would have 5/16-in. stock in height and thickness, and there should be a lip on the washer to go between the nut and the glass, to keep the hard metal of the nut from coming in contact with the glass."

"What is your idea of the best style of sheet packing for a steam-chest joint like that one there in that corner?" pointing to a well-known make of feed pump of the duplex type.

"What kind are you using?" said I, and he brought me a piece of material that I know is the best in the market, and I told him that he didn't have it in the joint, for if he had it there the joint would hold the life of the pump, and on close examination he found the joint packed with a piece of cardboard.

I began to think it near time to be making a move to the next plant, and on bidding the engineer good-bye he stated that just as soon as he could get straightened around he would send an order to the house or call me in and place it with me.

Now, this latter story had been doled out to me so many times that I was sure he was only giving me some waste flue gases, but I was surprised when I returned to the house to find not only a large order from him, but an order for 2 sets of pump valves from my first customer.

I have tried to show how widely different men in the engine room are and how easily some men can be disheartened by the rough treatment they get from the engineer. Many a man would have started on a run from the first plant I went to, at the first onslaught from the throttle twister. When you look at his action in the right light you will see that probably he may have at some time been bothered with fellows that are going through the country selling "cure-alls," that in reality are fakes and nuisances. With the second man that I called upon it is far different. He always greets the salesman in the right manner and not only helps the salesman by purchasing his wares, but benefits by the knowledge he acquires by inquiring of the salesman. If a man has a good article in his plant and doesn't know how to apply it, I'll show him every time, and if he is getting results with another firm's goods I will never knock that firm nor their goods, for that is, in my way of thinking, the shortest and quickest road to ruin as a salesman.

SPEAKING OF BROKEN cylinder heads which sometimes occur in the Diesel Engine, W. A. Tookey in The Power User, attributes this to the number of openings, the fuel injection valve in the center, air inlet and exhaust valves on either side, compressed air starting valve, all on the inner surface, and inlet and outlet for cooling water in addition in the outer plate. These passages are not subject to the same temperature, as the inlets are cooled while the exhaust is highly heated. The strains may, therefore, not unreasonably produce fracture in some cases.

This does not involve a new head, as the best thing is to patch it with a steel plate. First, fill the fissure with a softer metal which will penetrate the crack; then fasten the steel plate to the inner surface of the head with screws, using Smooth-On cement to get a joint between surfaces.

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HELP WANTED

The success of a speaker depends not on what he may think, but on what he makes his hearers think. The advertisement writer may not buy or use the thing he describes, but his advertisement must convince the readers. Accordingly, the employer wanting skilled men must study to word his advertisement so as to induce men of the kind he wants to reply. For the same reasons, the man wishing to secure a situation must write or talk, not merely to amuse himself, but to make his qualifications known to the employer.

When writing a "help wanted" advertisement to secure a man of definite abilities and experience, the question the writer must answer in his few lines of space is not, "What sort of a man do we want?" but rather, "What statements will interest the right man?" The effective advertisement will therefore state briefly the nature and scope of the work required, the previous experience the worker must have had to render him competent, the age and wage limits in the employer's mind, and the definite statement that replies will be held confidential. Such an advertisement may be read by hundreds of men, but will invite only those of the stated qualifications to reply. It is of little use to advertise for men of "energy," "force," "tact," and other mental characteristics, because all men feel that they have these, and will claim them if invited to do so.

The employer, however, has the easy end of the proposition. The man for the job has the difficult task of writing a letter that will make him stand out a real live, able man in the reader's mental vision. If his writing cannot be read easily, his letter will be put aside and probably buried under the others. If he spells badly, he may get no consideration from an employer obtuse enough to judge mechanics and clerks by the same standard. Evidently, the letter must be well written. It should tell much about the writer—how old he is, of what nationality, where brought up, schooled, trained and experienced, whether he has wife and children, and his proper expectation in wages. The names of his most prominent previous employers will lend weight to his claims of ability; but original references or stamped return envelopes only vex the busy man who has a dozen other applications to read and consider, and no time to waste on replies to those unsuccessful.

It is easy enough to write "Help wanted" advertisements that will bring dozens or hundreds of replies. It is extremely difficult to read through a pile of applications and pick out the few which really come from the men who could best fill the job. This being so, it is evident that the man applying for an advertised situation should do his best to make his letter tell his story effectively.

OUR FOREST RESOURCES

IN a circular on the status of forestry in this country, Treadwell Cleveland, Jr., says: "The forest is one of the chief supports of the whole material fabric of our civilization. The forest means not only a permanent supply of wood and the life of all the industries which depend upon it, but also the control of the waters for human use. There is only barrenness in the future of the nation which has lost the use of wood and the control of water.

"Taking stock of our resources has shown that we are still destroying the forest as we use it; that we are taking from it every year 3.5 times as much wood as is added by the new growth. It has shown that less than 1/3 of the growing trees felled by the lumberman is ever used at all, so that 2/3 of all the timber cut is simply destroyed. It has shown that 1/11 of all the forests are swept by fires every year, and that on the average since 1870 forest fires have yearly cost $50,000,000 in timber and 50 lives. It has shown that over 99 per cent of the forests in private hands—which comprise ¾ of all the forest land and 4/5 of all the wood—is thus devastated by destructive use and the scourge of unchecked fires, while less than 1 per cent is properly handled for successive crops or effectively protected from fire. The forest as a resource is rapidly being obliterated.

"But the inventory of the forests has had yet other ugly facts to reveal. With the disappearance and deterioration of the mountain forests the Nation is losing control of the streams, which are useful in our civilization in ways and degrees unparalleled by any other resource. Pure water for domestic purposes is, of course, indispensable; usable water at the right seasons is the sole reliance of the great projects by which the arid lands are vivified by irrigation; cheap water transportation is a matter of dollars and cents to every citizen; trustworthy power streams are the key to the age of electricity, at the gates of which modern industry is standing. Yet the guardian of the waters is steadily compelled to retreat before the ax and fire.

"In waste alone we reject more than 2/3 of the lumber that might be taken from the standing trees. At least half of this waste is unnecessary. In the first place, we waste the forest by refusing to take advantage of its full capacity for growth. Protected and properly managed, our forests will produce far more wood than they do at present. But while it is wasteful to cripple the forest by a violent lumbering which destroys young growth—the promise of the future forest—it is doubly wasteful to lock up the forest and let the ripe timber die and decay, for in the former case the forest at least contributes a temporary supply of wood, whereas in the latter case it contributes no wood at all.

"It is not use which destroys the forests, but waste. Not use as such, but destructive use, combined with inexcusable neglect, is causing the forests to dwindle under our progressive demands upon them. The problem, therefore, is not to be solved by disuse, but by wise use and protection. These together will so stimulate forest growth that the needed wood may be harvested without depleting the stock on hand, and will keep intact the protective cover at the stream sources."

What can be done in the way of a yearly crop is indicated by the averages from railroad records. Lumber is one of the chief freight commodities produced by land. Its weight per acre surpasses corn, barley, oats, wheat and rye.

The quantity of freight produced by a crop depends upon soil, region, and kind of crop. Railroads figure it from that point of view. Their profit depends upon tonnage and class, and they want to know what crop pays the carrier best.

Many averages in many localities are necessary to reach reliable results. Care is necessary, too, in applying to one region the figures obtained in another. Indiana, Illinois, and Kentucky are the center of a vast productive region, and averages there possess as much value as those of any part of the country, but, of course, they cannot be applied everywhere. An acre is credited with yield as follows:

Cabbage	21,000	pounds	per	acre
Onions	19,950	"	"	"
Potatoes	4,680	"	"	"
Lumber	3,000	"	"	"
Hay	2,710	"	"	"
Corn	1,728	"	"	"
Barley	1,219	"	"	"
Oats	886	"	"	"
Tobacco	877	"	"	"
Rye	848	"	"	"

As the list shows, the 3 heaviest freight producing crops are cabbage, onions, and potatoes; lumber is fourth. Up to the present time timber has been cut almost exclusively from wild land, without much regard to the acres gone over. But the time is coming when the yield of wood per acre will be calculated as carefully as the yield of corn, and as much thought will be given to growing it, though not as much work. How much wood grows on an acre in a year?

Some of the abused, burnt, washed, and neglected lands are producing only little. It has been estimated that the typical hardwood regions of Tennessee, where fire is kept out, are growing about 3000 lb. of wood yearly per acre. Good stands of young pines in other parts of the country are probably doing as well. But woodland can do much better. Good timber must be selected, the poor cut out, just as the farmer plants the best kinds of corn and rejects the poor. In Europe, where they raise crops of trees, they get, under favorable conditions, an annual growth of 4500 to 6500 lb. of wood per acre.

Woodland, under care, yields yearly crops as regularly as wheat fields. The marketable timber only is cut at regular intervals, and new growth is always coming on. As a freight producer, a timber tract may be depended upon as surely as a potato field. In fact, it is surer; for land in farm crops wears out unless constantly fertilized, but timberland fertilizes itself with its leaves, and becomes richer. It will yield undiminished crops forever.

FOR MANY YEARS North Carolina has been the largest producer of mica in the United States, according to the United States Geological Survey. Prior to 1895 the output came chiefly from the larger mines and consisted of big sheets of fine quality. At that time large quantities of small sheet mica that would cut plates less than 3 in. square were thrown on the dumps as waste. After the small sheet and scrap mica became valuable, the dumps at the large mines were worked over and the quantity of mica produced was thereby greatly increased. Now that most of the dumps have been worked over and only a few large mines are in operation, the output is barely maintained by a large number of small mines and prospects, probably as many as a hundred. Many of these are worked by the mountaineer farmer and miner at times when crops are laid by.

Power Apparatus in Shop and Market

New Ideas In Making, Buying and Selling

CHAPMAN ROTARY GAS PRODUCER

Revolving Sections of the Walls Maintains an Even and Uniform Bed of Fuel, Prevents Clinkers and Grinds the Ashes

AS shown in the accompanying illustration, the Chapman rotary gas producer performs 3 distinct operations, one for each of the 3 steps necessary to the process of making producer gas, viz:

1. Mechanical feeding and spreading the fuel.
2. Mechanical agitation of the entire fire bed.
3. Mechanical removal of the ash.

The first unique feature of this producer is that its mechanical feed has no mechanical parts. Another feature is that fine and coarse coal are handled simultaneously without separating the coarse from the fine.

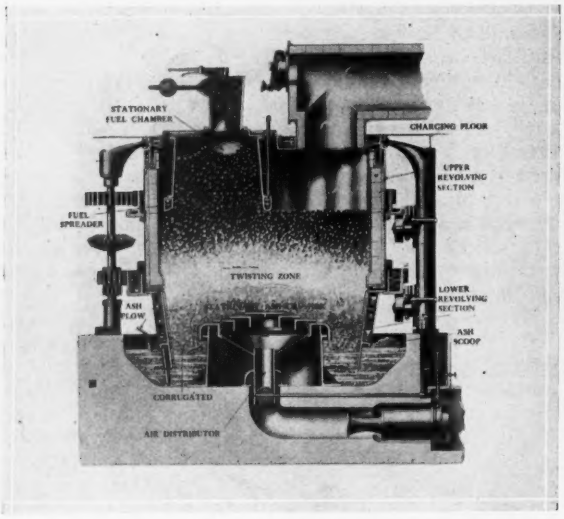


FIG. 1. CROSS-SECTIONAL VIEW OF CHAPMAN ROTARY GAS PRODUCER SHOWING PRINCIPLES OF OPERATION

The fuel chamber is stationary and has no bottom. It has a capacity of 1000 lb. of coal,—enough to last for half an hour. The lower edge is water-cooled. As the revolving fire bed comes under the chamber, a fresh supply of fuel is spread over the surface, thus constantly keeping the level of the fire bed up to the bottom of the fuel chamber.

The lower edge of the fuel chamber is beveled so as to produce a down-stroking effect upon the fire bed as it passes under it, thus "rubbing in" the fresh fuel.

An interesting feature of the Chapman feed is that it will feed the coal in unevenly as conditions require; for obviously when holes and crevices start to form in the surface of the fire bed, more coal is required at these points than elsewhere.

The fuel chamber prevents a rush of soot into the flues each time fresh fuel is charged into the producer. The tarry gas first given off from the coal in the fuel chamber must pass down through the hotter fire at the bottom of the chamber before it can escape to the flue. This reduces the amount of tarry smoke in the gas.

The second distinctive feature of this machine is the means used for agitating the fire bed. Some years ago the Chapman Company discovered that the

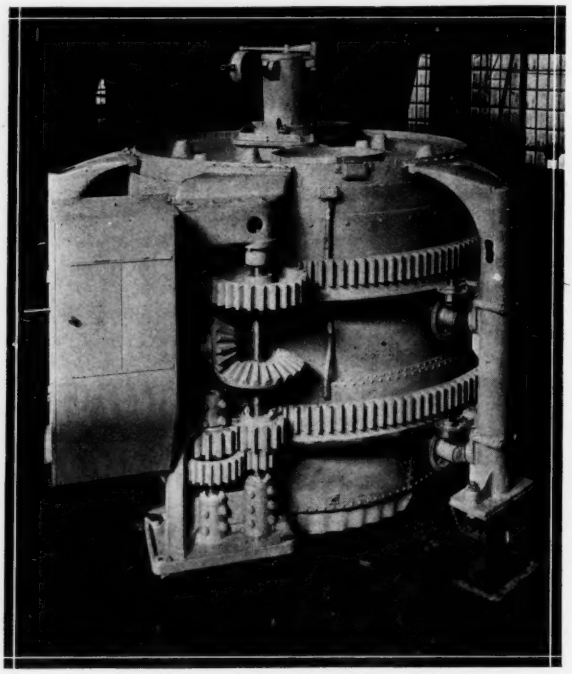


FIG. 2. CHAPMAN GAS PRODUCER ON ERECTING FLOOR AT FACTORY

best method of agitating a gas producer was to revolve one-half of the fire bed over the other, thus setting up a twisting and shearing action throughout the entire fire bed. The producer is therefore divided horizontally through the hot zone into an upper and lower section, and the 2 sections are made to revolve in the same direction, but at different speeds.

Each section of the wall carries with it that portion of the fuel bed which it surrounds. Thus the maximum amount of agitation is produced through the hot zone where it is most required. The unique feature of this second step in the process is that adequate agitation is obtained without recourse to an agitating member.

The chief difficulty in manufacturing producer gas is the prevention of clinkers. In the Chapman producer the twisting of the upper half of the fire bed over the lower, shears off the blow-holes as fast as they tend to form. This section together with the fuel spreader and the continuous ash removal, effectually prevents the formation of clinkers.

This freedom from blow-holes in the Chapman producer is evidenced in the unusually low temperature of the gas (about 1200 deg. F.) and also in the lack of soot.

The last step in the process of making producer gas, is removing the ashes which are first ground between the sides of the stationary corrugated air box or "ash crusher" and the revolving corrugated wall of the lower section. In mechanical producers, the crushing of the ashes is a necessary preliminary to their removal, as otherwise an occasional large chunk would block the operation. After the ashes have been crushed they are forced up to the top of the ash pan by 3 adjustable ash plows, which are kept continually in operation, and are easily adjusted when occasion requires.

As fast as the ashes are lifted to the surface of the water in the ash pan, they are automatically scooped up and carried to the required point for automatic discharge. The fact that the ashes in being removed are removed upward instead of downward makes a saving of several feet in the height required for the gas house and foundation.

As a result of the joint action of the automatic fuel spreader, the twisting of the fire bed, and the continuous removal of the ash, this producer may be made to gasify a ton of coal an hour.

The details of this machine have been worked out with unusual care. The supporting rollers run on high carbon steel pins, and are provided with brass bushings. These rollers are cast in a chill and ground. Separate rollers are used to take the side-thrust; all rollers are mounted in pairs set in equalizing yokes; all bearings are provided with large oil wells filled with waste after the manner of railroad cars. The faster gears run in oil. Steel castings are used extensively both in the gears and throughout the balance of the construction.

This producer is the invention of W. B. Chapman and is manufactured by C. & G. Cooper Co., of Mt. Vernon, Ohio.

FOR HEATING private dwellings where conditions permit it, the latest idea is to locate the heating plant in a separate building.

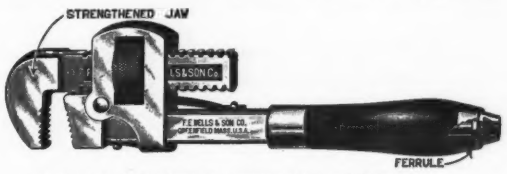
Removing of dirt from the residence, putting the handling of all coal and ashes at the rear of the lot, and reducing the fire hazard, are advantages secured by this method.

Of course, the heating plant must be sufficiently low so that the returns from the system will flow back by gravity, unless the establishment is large enough to warrant the use of some form of return pump.

Prevention of heat conduction from the underground pipes was accomplished in one instance by the use of Johns-Manville sectional conduit, which is impervious tile piping specially designed for such purposes. This was laid in 3-foot lengths, the lower half being put in to form a semicircular gutter into which the pipe was laid on roller supports. Asbestos sponge filling was then packed around the pipe, the upper half of the conduit sealed to the lower half, and the filling then put in above the steam pipe to fill the conduit.

AN IMPROVED STILLSON WRENCH

USEFUL improvements in the construction of the Stillson wrench have recently been made by F. E. Wells & Son Co., of Greenfield, Mass. As is shown in the accompanying illustration, the wood handles are protected by ferrules on both ends, which largely prevent breaking of the wood, and in case the wood does split the entire length of the



WELLS' IMPROVED STILLSON WRENCH

handle, will still hold the parts together. Jaws of the Wells wrenches have also been strengthened at the point where the greatest strain comes; namely, the angle between the head and the shank of the movable jaw. These wrenches release readily from the pipe, are strong and heavy, and are thoroughly tested before being sent out. They are fully guaranteed by the makers.

DIESEL ENGINES TO BE MADE BY WELL KNOWN ENGINE BUILDERS

ANNOUNCEMENT has just been made of unusual interest and importance in industrial and engineering affairs. A corporation has been formed with a New York State charter to engage in the manufacture, on an extensive scale, of a full line of Diesel engines, both stationary and marine. The company will be backed, not only by strong American interests, but also to a large extent by Swedish capitalists, who now control the Swedish Diesel Motor Co., which is known all over the world as one of the largest and most successful concerns devoted entirely to the manufacture of Diesel engines. These engines are built on the Hesselman system.

The new corporation will take over the plant and organization of the McIntosh & Seymour Co., of Auburn, New York, for many years known as builders of steam engines of the highest grade. The present steam engine business will also be continued as heretofore.

The name of the new corporation is McIntosh & Seymour Corporation. The Board of Directors is as follows: Marcus Wallenberg, President Stockholms Enskilda Bank, Stockholm, Sweden; Frank A. Vanderlip, President National City Bank, New York; Thatcher M. Brown, Brown Brothers & Co., New York; Edwin S. Church, Auburn, New York; J. A. Seymour, Auburn, New York; Franklin B. Kirkbride, New York City; Oscar Lamm, Stockholm, Sweden; Philip W. Henry, New York City.

The General Counsel is W. M. Coleman, New York City; Edwin S. Church, formerly Superintendent Akron Plant, International Harvester Co., will be executive head of the new corporation; J. A. Seymour, President of the McIntosh & Seymour Co., will be Vice-President, in charge of engineering. The initial capitalization will be $2,200,000, half common and half 6 per cent cumulative and participating preferred stock.

The Swedish Diesel Motor Co. started building these engines in 1898. Many of its designs of the most important features peculiar to the Diesel engine, such as the fuel pump, the atomizer, details of pistons, etc., have been purchased and adopted by many other leading builders of Diesel engines in Europe. Its chief engineer, K. Jonas E. Hesselman, although still a young man, has been knighted by the Swedish Crown in recognition of his distinguished achievements in this line.

The McIntosh & Seymour Co. in the past has run its plant night and day for many years. Its engines are installed in many of the larger and most successful steam plants in the country, besides which a large export business has been carried on to all parts of the world.

Many of the important European manufacturers of large steam and gas engines are practically concentrating their energies on building Diesel engines, and have such a large number of orders that it takes them from 1 to 2 yr. to make deliveries. It should be remembered that, notwithstanding the increase in the price of fuel oil, the actual cost of fuel oil and its relative cost, as compared with coal, is generally much lower in the United States than in Europe. Also that oil suitable for Diesel engines is a byproduct which will always be available in ample quantities as long as the present large consumption of gasoline and kerosene exists. Many large, new oil fields are also being developed in this country and Mexico.

Not only do Diesel engines offer advantages for central station units, factory and other isolated power plants, and railway service, but also for marine work where weight and space saved is of prime importance. The Diesel oil engine eliminates boilers, pumps, and many other accessories characteristic of steam equipment. The space so saved, and the coal-bunker space, can be used for cargo, and the liquid fuel handled by pumps, and requiring less than ⅓ the room required for coal, can be stored in the ship's double bottom. In view of these facts, there seems to be no reason why there should not be a broad field in this country for this type of engine.

In addition to furnishing exclusive licenses for their valuable patents for the Western Hemisphere, the Swedish interests in the new American Company insure their active aid and cooperation by furnishing a large part of the working capital, and, furthermore, will take an active part in the actual building of the American engines.

The McIntosh & Seymour Co., with its understanding of American conditions of manufacture and a highly developed plant and organization adapted for the immediate production of Diesel engines on a large scale, assures the success of the new enterprise.

Mr. Wallenberg, the principal stockholder of the Swedish Motor Co., and Mr. Hesselman, its chief engineer, have been in this country investigating the situation, and the sizes and speeds desirable to conform to American standards and conditions.

CORRECTION NOTE

IN the article on The Biggest Trap in the World, page 1161, Dec. 1 issue, a misstatement was made as to the designing of the trap, which was designed by and is the invention of J. W. Lytton, President of the Corporation.

ANDERSON AUTOMATIC VALVES

TO maintain constant water level in open feedwater heaters, tanks, etc., the Anderson Automatic Cushioned angle or globe water service valve has overcome many difficulties which have been encountered in this service. This is of the heavy pattern, and owing to its simple construction will operate under all the varying pressures. The pilot valve and float is attached to the valve or can be detached so that the pilot valve can be placed any distance from the main valve with small pipe leading to it.

Referring to Fig. 1, it will be noted that the upper portion of the body is lined with bronze which is all one casting, down to and including the seat. Also the piston and valve B is all bronze, fitted with a rubber, leather, or lead disc, according to the service to which it is put. This is, in fact a float held in suspension.

The water coming under piston B, also enters through port G on top of the valve opening to the greater area above the valve B for building head pressure according to the size of valve.

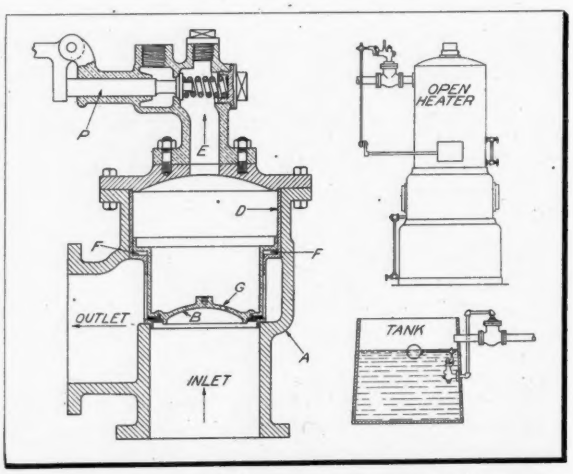


FIG. 1. SECTIONAL VIEW, SHOWING CONSTRUCTION AND CONNECTIONS OF ANDERSON AUTOMATIC CUSHIONED WATER SERVICE VALVE

A pilot valve, with copper float attached, is fitted to the top, or this pilot valve can be detached and placed any distance desired. When the water in the tank reaches the required height, the elevation of the copper float allows the pilot valve to close, which causes the pressure to build up above the piston B, forcing it to close, shutting off the flow of water through the valve. Water withdrawn from the tank or heater permits the float to drop, opening the pilot valve, allowing the pressure above the piston to lower just enough to permit the flow of water to restore the required level in the tank.

These valves are sensitive in their action and permit a small inflow of water or a large inflow of the full capacity of the pipe, according to the amount of water withdrawn from the tank.

In Fig. 2 is shown the Anderson electrically operated water pressure regulating valve, which is provided with an automatic device which is cushioned in opening and closing, has double seats and is quick in opening. The valve, as shown in section, is in a closed position. When the spring B is adjusted by the nut A to the required pressure, the valve discs at H and I are forced open. The high pressure or inlet

is at E; the low pressure or outlet is at F. When the pressure on the low side has reached the pressure at which the valve or spring B is set, the pressure, still increasing, exerts a pressure on top of piston J (the valve H and piston D being balanced), causing the valves H and I to close. In order to have the valve open freely and at the same time close slowly, there is placed a ball check K in the bottom of the dashpot G. The ports L, placed in the upper rim of the dashpot G, prevent any accumulation of air while the valve is in service.

The water above and below the piston D, and the air beneath the piston J, absolutely prevent any water hammer and perfectly cushion the valve in opening and closing.

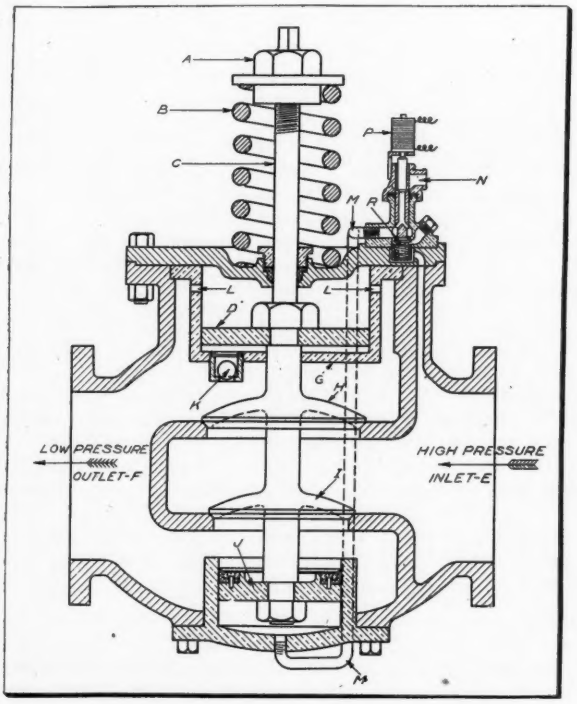


FIG. 2. CROSS-SECTION OF ANDERSON ELECTRICALLY OPERATED PRESSURE REGULATING VALVE

The solenoid P, which controls the auxiliary valve R, is wired to a switch at the pumping station or any other convenient point, and, in case of fire, the switch is thrown into contact, which causes the solenoid P to open the auxiliary valve R, allowing high pressure from the inlet side of the main valve to pass up through the auxiliary valve and down through the small pipe M, to the under side of the piston J, which causes the main valves H and I to open to the full area. When the full pressure is no longer required, the switch is thrown out of contact. This allows the auxiliary valve to close and the pressure from the under side of the piston J returns through the auxiliary valve, exhausting at port N. The pressure being released from under the piston J, the main valves H and I will automatically return to the regulating position without the necessity of readjusting the reducing feature.

These valves are manufactured by the Golden-Anderson Valve Specialty Co., of Pittsburgh, Pa.

RED CROSS CHRISTMAS SEALS

THE Red Cross Christmas seal is again with us. It reminds us that the season of good will is at hand, when each of us should do something toward relieving some of the sorrow and suffering in the world. Thousands of earnest men and women throughout the country are enlisted in the great crusade against tuberculosis, giving freely of their time and money to stamp out this dreaded disease. The bright little Red Cross seal, which carries with it a message of the season's greetings, offers all of us an opportunity to enlist in this crusade for humanity and contribute our mite to the cause.

The fight is not a hopeless one. Since the Red Cross seal made its first appearance 6 yr. ago, the death rate from consumption has been reduced 25 per cent in some of our largest cities. Still we have upward of 1,000,000 cases of tuberculosis in the United States and the fight must go on with increasing vigor.

That tuberculosis can be cured, if given the proper treatment in time, is no longer a matter of dispute. Sufferers need not seek a change in climate, which is financially impossible for many. They can be cured in the localities where they live. Experts point out the way and the funds derived from the sale of Red Cross seals furnish the means.

Help the cause by the liberal use of Red Cross seals on letters and packages during the holiday season. They are on sale in department and drug stores and orders may be sent direct to the Chicago Tuberculosis Institute, Otis Building, Chicago.

GERMAN TESTS on the effect of a smoke consumer, the Marcotty, which works by admission of extra air supply above the fire for a period after stoking, show that for a locomotive the combustion was much more complete and carbon monoxide, hydrogen and carbohydrates were practically eliminated. Carbon dioxide was decreased from 13.78 per cent without the consumer to 12.98 per cent with it, and oxygen content rose from 1.72 per cent to 5.9 per cent, but carbon monoxide fell from 3.6 per cent, hydrogen from 1.32 per cent and CH_4 from 0.42 per cent to practically nothing. Nitrogen rose from 79.16 per cent to 81.04 per cent. The temperature without the consumer was 581 deg. F. in the flue, and 788 deg. F. with the consumer, so that the stack loss by heat in gases increased from 10.41 per cent to 19.85 per cent, but the losses from incomplete combustion were reduced from 18.71 per cent without the extra air supply to 0.47 per cent with the supply, so that there was a considerable net gain from use of the consumer. The author advises automatic operation of the consumer to avoid adding to the work of the fireman, which in locomotives is sufficiently arduous without added duties. In stationary practice the consumer would probably make a still better showing.

EVERETT F. MORSE

WITH deep regret the Morse Chain Co., announces the death of E. F. Morse, which occurred at his home at Ithaca, N. Y., on Tuesday, November 11.

Everett Fleet Morse was born at Ithaca, June 28, 1857. When only 16 yr. of age he patented an improvement on the horse-drawn Lag rake and made good use of the earnings from his first invention to supplement other efforts to give him an education. He attended Cornell University in 1875, and, after being out several years, graduated with the class of 1884 as mechanical engineer. After spending some time in Algone, Iowa, where he was manager of a flax mill, he returned to New York state and settled at Trumansburg. Here, in 1893, he patented the Morse rocker-joint chain for bicycles, and in conjunction with his brother, F. L. Morse, founded the Morse Chain Co. and began the manufacture of bicycle chains. The correct mechanical principle embodied in this chain, as well as its novelty, attracted immediate attention and eventually secured for the company a profitable business which lasted until the phenomenal slump in the bicycle trade, about 1897.

In the meantime, F. L. Morse, who has been the active manager of the Chain Co. for the past 13 yr., developed the present type of silent chain for power purposes, and during 1906 built the new plant at Ithaca, N. Y., where the business has grown from small beginnings to its present proportions.

At the time of his death, E. F. Morse was a director and secretary of the Chain Co., but for some years past he has devoted himself largely to his heat-gage interests and to various public duties, in which he was most active and efficient.

The Morse Thermo Gage, which Mr. Morse invented and patented in 1900, is a most ingenious device for the measurement of the temperature of steel, and won him much distinction at home and abroad, having been adopted by both the United States and German Bureaus of Standardization. In recognition of the high mechanical merit of the rocker-joint chain and thermo gage, Mr. Morse was awarded medals by the Franklin Institute, an honor attained by few inventors.

NEWS NOTES

A. G. MACHESNEY, for 15 yr. Traveling Engineer and Locomotive Inspector with the Baldwin Locomotive Works, has become associated with the Railway Division of the Detroit Lubricator Co.

THE TORONTO BRANCH of The Canadian H. W. Johns-Manville Co., Limited, announces its removal to more spacious quarters at No. 19 Front Street, East. This new store and warehouse has a floor area of approximately 35,000 sq. ft. and is situated in the heart of the wholesale district.

IN ORDER to take care of the big increase in its volume of business, the Baltimore branch of the H. W. Johns-Manville Co. has been compelled to seek larger quarters. The new home of the company is a modern, 6-story building with floors measuring 47 by 187 ft., located at 207-13 E. Saratoga St., which is within 2 blocks of the Post Office and right in the heart of the business section. It will include an attractive store and up-to-date offices, in addition to large warehouse accommodations. To facilitate the handling of incoming and outgoing shipments there will be a railroad switch running into the building.

AN ORDINANCE AUTHORIZING a franchise to A. F. Heeb, T. J. Mulgrew and T. J. Fitzpatrick, brings to and locates in Oelwein, Iowa, a new $75,000 electric light plant, fully equipped in every respect.

THE COACHELLA VALLEY Power & Electric Co. is issuing $400,000 worth of bonds to build a power line from Banning, Cal., to the Imperial Valley, making it the longest power line in the world, 398 miles. Current will be 3 phase, 55,000 v., and will furnish 3000 hp.

DEVELOPMENT OF WATER POWER RESOURCES on the west slope of the Cascade Mountains on a scale never before attempted in the West, entailing the investment of enormous sums of money within the next 10 yr., is planned by Stone & Webster interests. Purchase of water power rights and lands on Baker River and Bear Creek, Skagit County, worth $200,000, is involved in the construction of a hydro-electric power plant generating

MAYOR BAKER, OF CLEVELAND, O., and his new cabinet members have mapped out plans for immediate completion of the $2,000,000 municipal electric lighting plant, thus clearing the way for what is now declared in city hall circles to be the next big issue, the purchase by the city of Cleveland of the Cleveland Railway Co. At the meeting of the department heads it was decided to proceed with the issue of nearly $2,000,000 worth of bonds. About $300,000 will be required to complete the lighting plant and it is probable this amount of bonds will be sold to the city sinking fund commission to save time.

THE GREATEST POWER PROJECT in the South has been declared complete and put into operation with the formal opening of the $9,000,000 power plant, lock and dam at Hale's Bar, 11 miles down the Tennessee River from Chattanooga, Tenn. With the dam put in operation, Chattanooga and the surrounding district will be supplied with 65,000 hp. each day, a sufficient quantity of electricity to operate 25 cotton mills or to run all the trains on the Chattanooga & Nashville Railroad. The power plant, which ranks with that at Keokuk, Iowa, on the Mississippi, and the plant at Niagara Falls, will be operated by the Chattanooga and Tennessee Power Co.

ENGINEERS OF the Pacific Gas and Electric Co. are making a final inspection of the Bear River development in California, preparatory to turning through the water.

The site of Lake Spaulding dam, which is the principal part of the development, was acquired by the present owners in 1905, and surveys were made in the following year. Construction started in July, 1912, and the first concrete was placed in the river bottom Nov. 15 of that year. The last concrete was placed at an elevation of 242 ft., Nov. 17, 1913, the actual pouring of concrete requiring approximately 6 months. The volume of concrete placed in the dam averaged about 1000 yd. a day, or about the volume that goes into a large metropolitan skyscraper. The total yardage placed was 155,000, and it is said that the speed of pouring during the construction of the dam was never equaled.

The present height of Lake Spaulding dam will permit of developing 33,000 hp. with the first installation at Drum, the first of a series of 6 plants reaching below Auburn. It is expected that the total development will provide 150,000 hp. The ultimate height of the dam will be 320 ft.

The cost of the plant to date has been $5,000,000, although its completion is expected to cost $15,000,000. This provides for the installation of 5 additional generating plants, more than half the work on 3 of them having been completed. It is expected that 4 plants will be in operation by the middle of 1914.

CATALOG NOTES

BROWNHOIST BUCKETS AND TUBS are described in Catalog E from the Brown Hoisting Machinery Co., Cleveland, Ohio.

A RADIATOR VALVE That Can't Leak is the title of a booklet just issued by Detroit Lubricator Co., giving the advantages of Detroit Packless radiator valves, with illustrations and roughing-in dimensions.

MOUND TOOLS for the Engineer, the 1914 catalog of Mound Tool Co., St. Louis, Mo., has just been received. The company will be glad to send a copy of this catalog to any interested engineer.

THE LUNKENHEIMER CO., of Cincinnati, Ohio, has recently issued a booklet describing and illustrating Lunkenheimer regrinding valves. A copy of the booklet will be sent to anyone interested.

"LITTLE DAVID" pneumatic drills are described in Form No. 8107, recently issued by Ingersoll-Rand Co., 11 Broadway, New York. Illustrations show the drill partly in section, the valve action, the drill at work on the deck of the largest battleship afloat and figuring in various repair jobs.

FOXBORO RECORDING HYGROMETER, a new type instrument by which to obtain relative humidity, combines 2 instruments in one—a recording thermometer and a wet bulb recorder. Bulletin No. 75, describing it and giving a facsimile record made by a 10-in. Foxboro Improved recording hygrometer, was recently received from The Industrial Instrument Co., Foxboro, Mass.

FOLDER 4266 issued by the Westinghouse Electric & Mfg. Co., entitled The Electric Breakfast Set, describes and illustrates in an interesting manner the use of the Westinghouse toaster stove and coffeepot type percolator, and shows how easily a breakfast can be prepared by these convenient devices. The total time required for the preparation of the breakfast is 15 min., and its cost of operation 2c., based on 10c. per kw.-hr. for current.

ENGINEERS WHO KEEP a file of books for reference will be interested to know that the Joseph Dixon Crucible Co., Jersey City, N. J., still has a limited number of booklets dealing with such subjects as Steam Traps, Unions for Steam Pipes, Feeding Graphite for Lubricating Purposes, etc., which will be sent free, as long as the supply lasts, to anyone who cares for them.

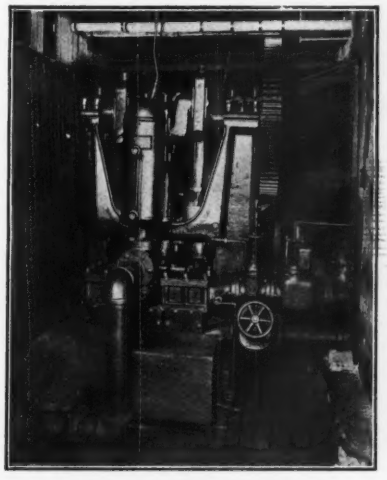
SPACE OCCUPIED by Water-Tube Boilers is the subject of a pamphlet giving a reprint of a paper read last April before the Associated Engineering Societies. The purpose of the paper is to show that the floor space occupied by boilers per rated horsepower influences the cost of a boiler plant by an amount totaling from $1 to $10 per hp. A number of drawings, charts and tables are given in the pamphlet, which is published by the Heine Safety Boiler Co., St. Louis, Mo.

A PAMPHLET ENTITLED Problems in Physics has been received, which is intended to accompany the recently published Textbook of Physics by A. W. Duff and others. This pamphlet contains numerous examples on the different subjects, including Mechanics, Heat, Light, Sound and Electricity, and will be furnished free to all students using the textbook. To others a charge of 10 cents per copy is made. The pamphlet is published by P. Blakiston's Son & Co., 1012 Walnut St., Philadelphia.

TRADE NOTES

IN THE ISSUE of November 15, an item in regard to special material which will take the place of flange gaskets for making joints in piping, spoke of this material, which is made by the Caledonian Oil Co., as being applied by a special tool. This was an error, as any spreading tool will serve the purpose, no special tool being required.

THE PUMP ILLUSTRATED, made by the Goulds Mfg. Co., Seneca Falls, N. Y., was installed in the Butts Bldg., Rochester, in 1893. It is used to supply water to a 48-in. by 16-ft. compression tank from which the elevators are operated. The pump is driven by an automatically controlled electric motor and operates against a pressure of 90 lb. per sq. in. With



the exception of the occasional renewal of the valve disc, no repairs were made on this pump until August, 1910, when new plunger pins and bushings were put in, and later, in 1912, when the plungers, glands and rawhide pinion were replaced. Until this time, the pump contained all original parts just as it left the factory 19 yr. before. The engineer in charge states that he has never had any trouble with the outfit during the 21 yr. it has been in service, and today it is operating as smoothly and efficiently as it did when installed.

$1000 FOR AN IDEA seems like a large amount to pay. But in a field like advertising, an idea may mean hundreds of thousands of dollars in increasing the effectiveness of the selling expenses of manufacturers. Recognizing this fact, Advertising & Selling Magazine of New York has offered $1000 in cash for that article which will do most to push forward the development of advertising or selling. The award is to be made at the Advertising Convention at Toronto, and the decision of merit will be made by the Awards Committee of the Association. Full information can be had from Advertising & Selling Magazine, 95 Madison Ave., New York City.

THE CLEVELAND (SIXTH CITY) BRANCH of the H. W. Johns-Manville Co. has recently been obliged to provide larger quarters for several of its subsidiary offices. The Columbus Office and Contract Department are now located on the ground floor of the new 7-story, fireproof Peters Power Building, 45 West Long Street, with large warehouse facilities half a block distant. The Toledo Office and ware-

house have been moved to 213 Water Street. This office has just completed a pipe covering, stack lining and cork tiling job in the Second National Bank Building, Toledo, which possesses many unique features. Other Cleveland Branch sub-offices are located in Akron (717 Second National Bank Building), Dayton (259 Fourth Street Arcade), and Youngstown (502 Stambaugh Building). Resident representatives are stationed at Lima, Massillon, Greenville and other points in Ohio, also at Huntington and Parkersburg, W. Va. Their work is supplemented by a large corps of traveling men. Last, but not least, the Cleveland Branch has just closed a long-term lease for another larger warehouse on Front Street, which, when remodeled, will give the branch larger and better storage and shipping facilities than ever.

THE SIMS COMPANY, of Erie, Pa., has had a remarkably successful career and has grown so rapidly that the old plant would no longer accommodate the needs for expansion, and a splendid new, modern building has been erected at Eighteenth Street and Whitley Avenue, on the Nickel Plate Railroad.

The new building is erected on a site of 4 acres and is 100 ft. wide and 200 ft. long, made of steel frame, concrete foundation, brick and hollow tile walls and steel window frames. There is a 30-ft. gallery around 3 sides of the building, on which the sheet-iron products are built, and a portion used for storage purposes. There is a spur of the railroad running through the entire building, which, together with a 15-ton crane and a 40-ft. span, makes the loading of the products a simple matter. There is a 650-ft. track frontage on the railroad along one side of the new property belonging to the company, which makes ample provision for the future growth of the concern.

The products of the Sims Company include feed-water heaters, hot-water generators, laundry heaters, sugar-juice heaters, special heaters of all kinds where steam is used as a means of heating; steam separators, exhaust heads, oil filters and steel storage tanks of all kinds.

Among the recent orders received by this company are included a 6000-hp., closed type feed-water heater for the Schade Valve Manufacturing Co., of Philadelphia; a 2500-hp., close type feed-water heater for the Continental Rubber Co., of Erie; 2 2500-hp., closed feed-water heaters for H. L. Peiler & Co., Canadian agents, at Montreal; a sugar-juice heater for Porto Rico; 2 water heaters, 60 in. by 144 in., for the State Hospital for Insane, Rochester, Minn.; 2 water heaters, 48 by 120, for State Training School at Red Wing, Minn.; one 800-hp. open heater for the New Berne Water Co., of New Berne, N. C.; another of the same size for the Middle States Coal and Coke Co., of Carswel, W. V.; another of the same kind for the Merchants Dispatch Transportation Co. of Rochester, N. Y.; another of the same kind for Mead-Morrison Manufacturing Co., of Boston, Mass.; one 1500-hp. open heater for Harper Hospital, Detroit; one water heater, 48 by 144, for the Virginia Hotel, Columbus, Ohio; 2 water heaters for the City Hospital, Minneapolis, Minn.

The Sims Company has started a new line in the manufacture of garbage and refuse burners for hotels and apartment buildings, to be known as the "Sims" Water Heater and Garbage Burner. In this line this company has already furnished 3 for the Montana Apartment New York City; and is building one for a large restaurant in Detroit.

PRACTICAL ENGINEER

Trade-mark, Reg. U. S. Pat. Off.

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PUBLISHED ON THE FIRST AND FIFTEENTH OF EACH MONTH

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Positions Wanted

POSITION WANTED—By young man, as second engineer, or will take complete charge of small plant. 7 years' experience. Tools, indicator and references. Sober, industrious and agree with work. Open for engagement by Nov. 1st. Box 15, Argyle, Minn. 12-1-2

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POSITION WANTED—By engineer. At present employed in plant of 2000 H. P. Have had 10 yrs.' experience in large plants. Mass. license. Address Box 327, Practical Engineer. 12-1-2

POSITION WANTED—Chief Engineer, factory power plant, wide experience; result producer. Address Box 329, Practical Engineer. 12-1-2

Wanted

IF YOU RECOGNIZE the value of approved specialties in an engine and boiler room as a means of higher efficiency; if you believe in this sort of thing to the extent that you think you could sell a well-known boiler specialty in your territory for an old established manufacturer in the power plant field, write and tell us all about yourself. On receipt of your letter we will outline our proposition in full. Address Box 324, Practical Engineer. tf.

WANTED—September 1st issue of Practical Engineer. If you have a copy of September 1st, 1913, in good condition, that you can spare, send it to us before January 1st, 1914, and we will extend your subscription two months. Address Circulation Department, Practical Engineer, 537 S. Dearborn St., Chicago.

WANTED—EVERY ENGINEER to have our pamphlet for setting valves on Corliss Engines, single and compound, with one or two eccentrics. Sent free. Lindstrom's Machine Works, 200 South Third St., Allentown, Pa. tf.

IF YOU ARE a night engineer, spend a few hours each day taking subscriptions for Practical Engineer. You will be paid well. Write Subscription Dept. They will start you in at once.

WANTED—Every local Engineers' Association to have an assortment of valuable power-plant books—Secretary write at once, for full particulars. Address Dept. C., Practical Engineer, Chicago.

WANTED—ALL STEAM USERS to have clean boilers without using compounds or chemicals in any form. Write "Otis," No. 317 Norfolk Ave., Buffalo, N. Y. tf.

WANTED—Secretary of local Engineers' Association to write us at once in regard to a very interesting proposition. Address Practical Engineer, Circulation Department.

Help Wanted

WANTED—An additional subscription solicitor wanted to cover towns in the state of Indiana. Excellent chance to earn extra money. Write to Subscription Department. tf.

For Sale

DIRECT-CONNECTED UNIT FOR SALE—100-kw., 440 or 220-volt, direct-current, Western Electric Generator, direct connected to Shepherd Vertical enclosed automatic engine, in use about 1½ years on temporary work, like new. Cheap before removal. H. P. Brearley, 90 West St., New York, N. Y. 12-15-2

FOR SALE—14 by 42 Wheelock Engine Wheel, 9 ft. by 20 in. Also Bulkley Condenser in first-class condition, and National Heater with double coil, back-pressure valve and exhaust head. Address M. Heminway & Sons Silk Co., Watertown, Mass. 12-1-2

OUR MODERN BLUE PRINT CHART method of electrical wiring. Write for information. Electrical Wiring Diagram Co., Box F173, Altoona. Pa. 11-15-12

FOR SALE—24 by 48 Hamilton Corliss Engine, having tangye frame (practically new), $1200; immediate shipment. Duzets & Sons, 40 Church St., New York. 12-1-2

WE HAVE FOR SALE one 125-hp. boiler and engine complete; also 75-light generator. For full description and prices, address Northern Milling Co., Wausau, Wis. 12-15-2

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PATENT SECURED or fee returned—Send sketch for free expert search and report as to patentability. Books on inventions and patents, and reference book sent free. John S. Duffie & Co., 607 F St., Washington, D. C. tf.

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PATENTS—C. L. Parker, Attorney-at-Law and Solicitor of Patents. Patents secured promptly and with special regard to the legal protection of the invention. Handbook for inventors sent upon request. 186 McGill Building, Washington, D. C. tf.

PATENTS—H. W. T. Jenner, Patent Attorney and Mechanical Expert, 606 F St., Washington, D. C. Established, 1883. I make a free examination and report if a patent can be had and the exact cost. Send for full information. tf.

PATENTS SECURED. Legal protection our specialty. Booklet free. Harry Patton Co., Suite 330, McGill Building, Washington, D. C. tf.

PATENTABLE IDEAS WANTED—Send for 3 free books. R. B. Owens, 28 Owen Bldg., Washington, D. C. tf.

Educational and Instruction

ENGINEERS' POCKET MANUAL, 175 pages, edited by University of Tennessee, will be mailed every subscriber sending in one new subscription to Practical Engineer. Gild edges; bound in leather.

ENGINEERS AND FIREMEN—Send 10c in stamps for a 40-page pamphlet containing a list of questions asked by an examining board of engineers. Stromberg Publishing Co., 2703 Case Ave., St. Louis, Mo. 11-15-5

Miscellaneous

ENGINEERS desiring valuable data on Boiler Operation, should write for our new booklet—it's free if you tell us where you saw our ad. The Federal Graphite Mills, Cleveland, Ohio. 11-15-3

IF YOU ARE an operating engineer, we know the Fetta Hot Process Water Purifier will interest you. We would be glad to have your request for further information. Address the Fetta Water Softener Co., Richmond, Ind. tf.

ENGINEERS—DO YOU WANT to utilize your exhaust steam for heating or drying purposes, without back pressure on your engine? If so, address Monash Engineering Co., 1413 W. Jackson Blvd., Chicago, Ill. tf.

MAKE MONEY on the side. Here's your chance to work out some money for yourself. Get subscriptions for Practical Engineer. It pays well. Just drop a line to the Subscription Dept. They will tell you. tf.

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PUBLIC SERVICE COMMISSION
OF NEW JERSEY.

Sparks On The Advertising Pages

Pick up almost any newspaper or magazine and you can find abundant reasons why manufacturers *should* advertise. In this issue we shall add the spice of variety by telling why some manufacturers *should not* advertise.

Advertising will not prove a profitable investment when the product is not adapted to the need of the times; is not in line with the trend of practice; is not free from every hint of deception; and is not given the benefit of conscientious skilled workmanship and rich quality.

The profit side of Advertising seldom lies in direct sales from a single advertisement, or even the first orders obtained from a campaign. Rather, it is developed through the accumulative trade of customers gained by advertising, and who become *permanent customers* through *satisfaction.*

This fact has been well established. The trail of advertising is dotted with the bones of failures —firms that thought printer's ink would cover a multitude of sins. The lesson has gone home, and, as a consequence, inferior products are rarely ever advertised; their sales depending mostly on methods less open and which do not invite searching investigation. Their makers realize that their quality will not retain the purchaser as a *permanent customer.*

With the years has come a closer watchfulness of the advertiser by the publisher, until it is now practically impossible for a known exaggerating or misrepresenting advertisement to get into the columns of any reputable periodical.

Practical Engineer has long rigidly maintained this rule. It will not accept any advertisement which seems to show the least taint. It invites only the advertising of machines, appliances and apparatus which have the ability to prove permanently successful, in power plant operation. It endeavors to make its advertising pages as clean as its editorial pages.

A policy of this kind brings its own reward. There is the consciousness of a good deed well done, and in addition the realization that it is appreciated by its subscribers. Among the significant letters received recently is one from Will McCallum, Alpena, Mich. He says of Practical Engineer:

"I have all my back numbers right on the job for reference at all times.

"I find your advertising pages the best of any magazine that we have around our power house and we have all the leading ones."